ENVIRONMENTAL MONITORING

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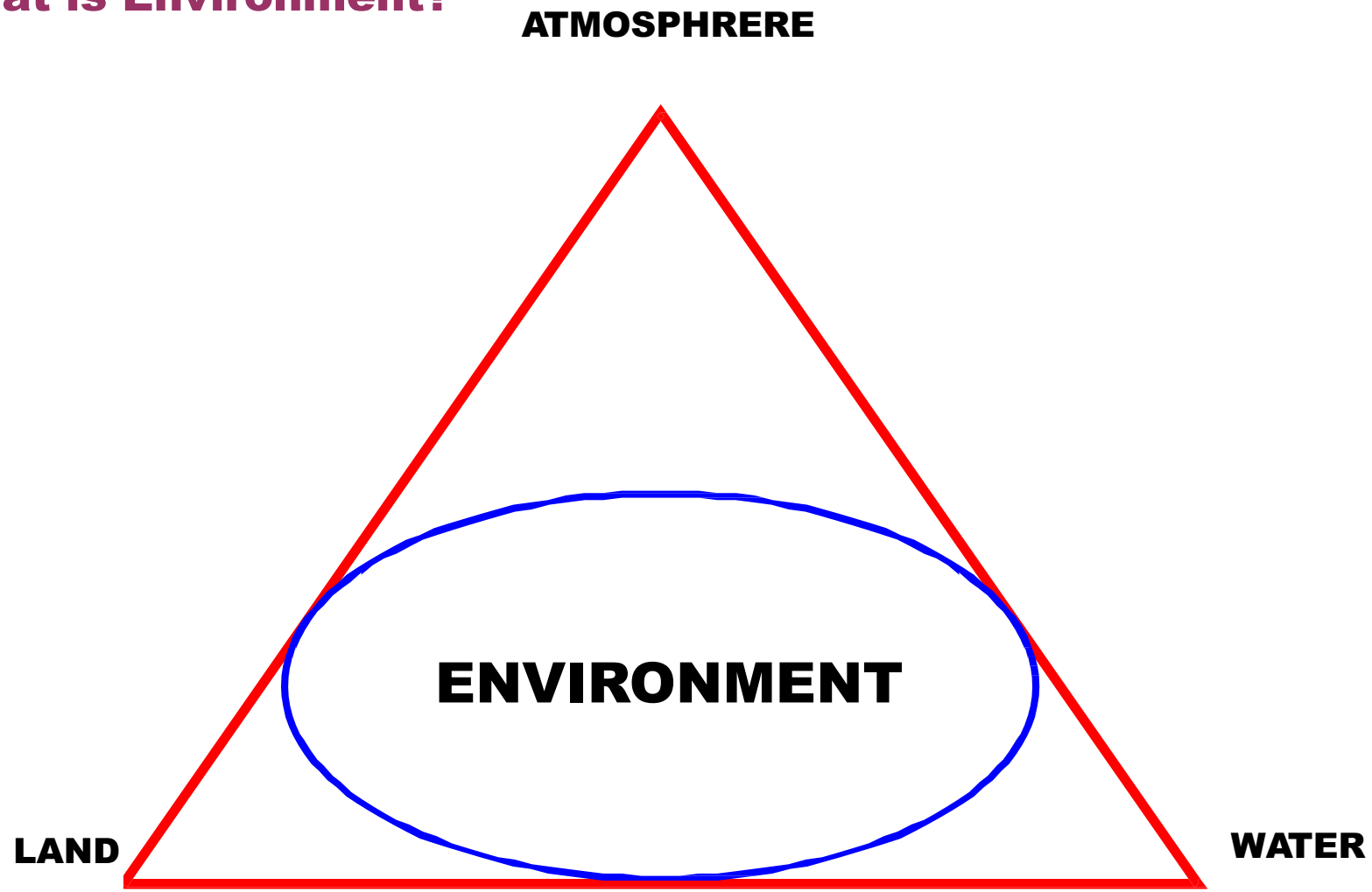
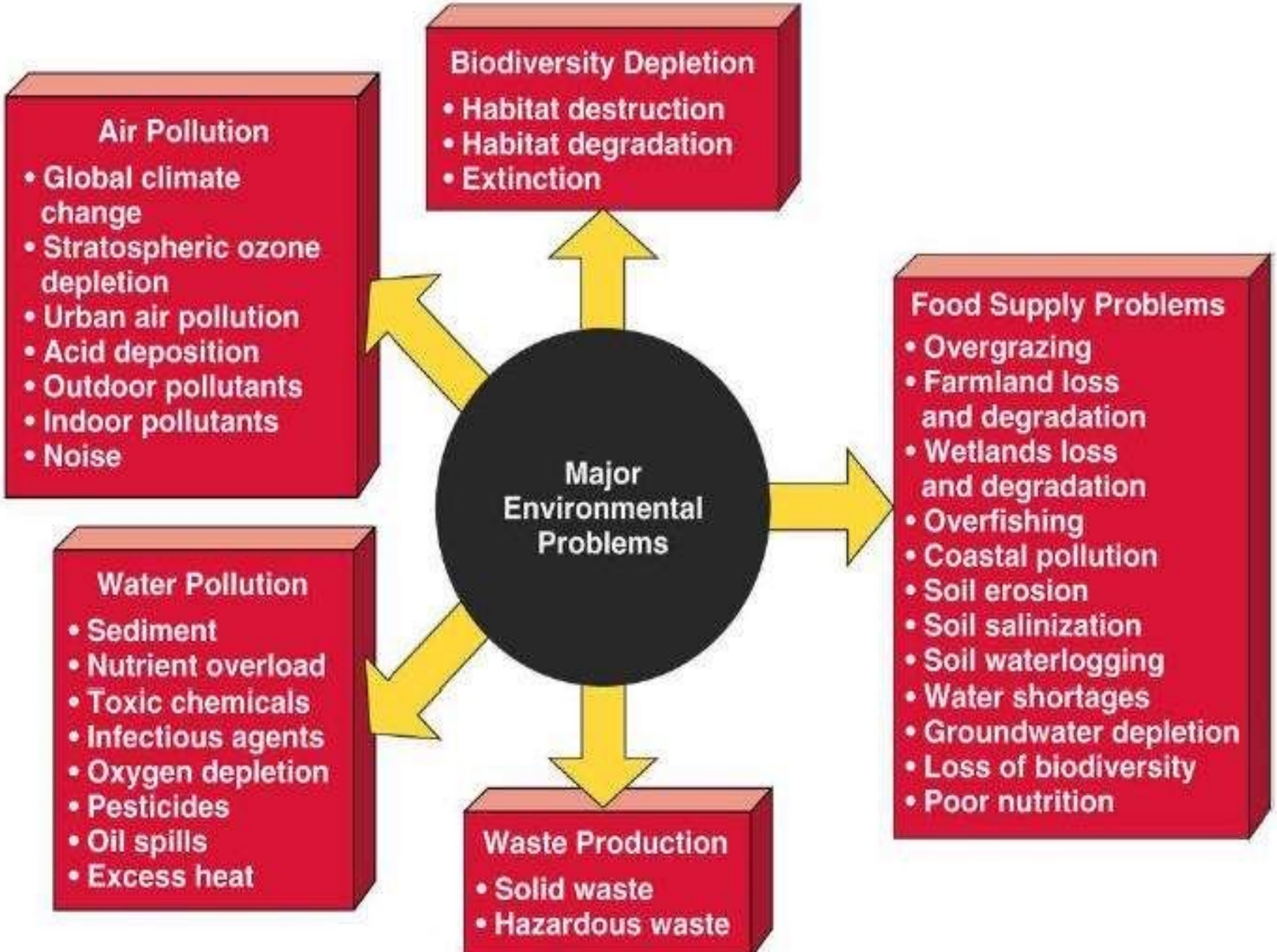
What is Environment?




Biodiversity Depletion
• Habitat destruction
• Habitat degradation
• Extinction
Air Pollution
• Global climate change
• Stratospheric ozone depletion
• Urban air pollution
• Acid deposition
• Outdoor pollutants
• Indoor pollutants
• Noise
Major Environmental Problems
Food Supply Problems
• Overgrazing
• Farmland loss and degradation
• Wetlands loss and degradation
• Overfishing
• Coastal pollution
• Soil erosion
• Soil salinization
• Soil waterlogging
• Water shortages
• Groundwater depletion
• Loss of biodiversity
• Poor nutrition
Water Pollution
• Sediment
• Nutrient overload
• Toxic chemicals
• Infectious agents
• Oxygen depletion
• Pesticides
• Oil spills
• Excess heat
Waste Production
• Solid waste
• Hazardous waste

ENVIRONMENTAL MONITORING

can be defined as the systematic sampling of air, water, soil, and biota in order to observe and study the **environment**, as well as to derive knowledge from this process.

OBJECTIVE OF MONITORING

Monitoring of the environment may be undertaken for a number of reasons. In general monitoring is done in order to gain information about the present levels of harmful or potentially harmful pollutants in discharges to the environment, within the environment itself or in living creatures that may be affected by these pollutants. This definition can be expanded as follows:

- Monitoring may be carried out to assess pollution effects on human and his environment in order to identify any possible cause and effect relationship between pollutant concentration and health effects, climatic changes etc.

– To evaluate pollution interactions and patterns
– To assess the need for legislative controls and emissions of pollutants and to ensure compliance with emission standards.

ENVIRONMENT MONITORING METHODS

- Ground-based Sampling and Measurements
- Model-based Monitoring
- Satellite based Monitoring

Satellite Based Environment Monitoring Areas

- Atmosphere Monitoring
- Air Quality Monitoring
- Climate Change Studies
- Resource Management
- Glaciers and Snow
- Flood and Drought Management
- Landuse / Landcover
- Weather Prediction
- Hazards Monitoring
- Aviation
- Agriculture
- Marine & Phytoplankton Studies
- Dust Storm

TYPES OF MONITORING

1. SOURCE MONITORING
2. AMBIENT ENVIRONMENT MONITORING

1. SOURCE MONITORING

- This may be carried out for a number of reasons

- Identification and characterization of main sources in urban areas.
- Determination of the mass emission rates of pollutants from a particular source and assessment of how these are affected by process variations.
- Evaluation of the effectiveness of control devices for pollution abatement.
- Evaluation of compliance with statutory limitations on emissions from individual sources.

2. AMBIENT ENVIRONMENT MONITORING

- Monitoring the environment may be carried out for a number of reasons:
- Mapping the concentration of pollutants in the environment.
- Identification of pollution sensitive zones.
- Identification of possible sites for the environmental monitoring stations.
- Tracking progress towards National Quality Standards attainment and emission reductions.
- Serve as the basis for modeling of predicted pollutant concentrations in ambient air.
- Provide input for human health risk assessment studies.

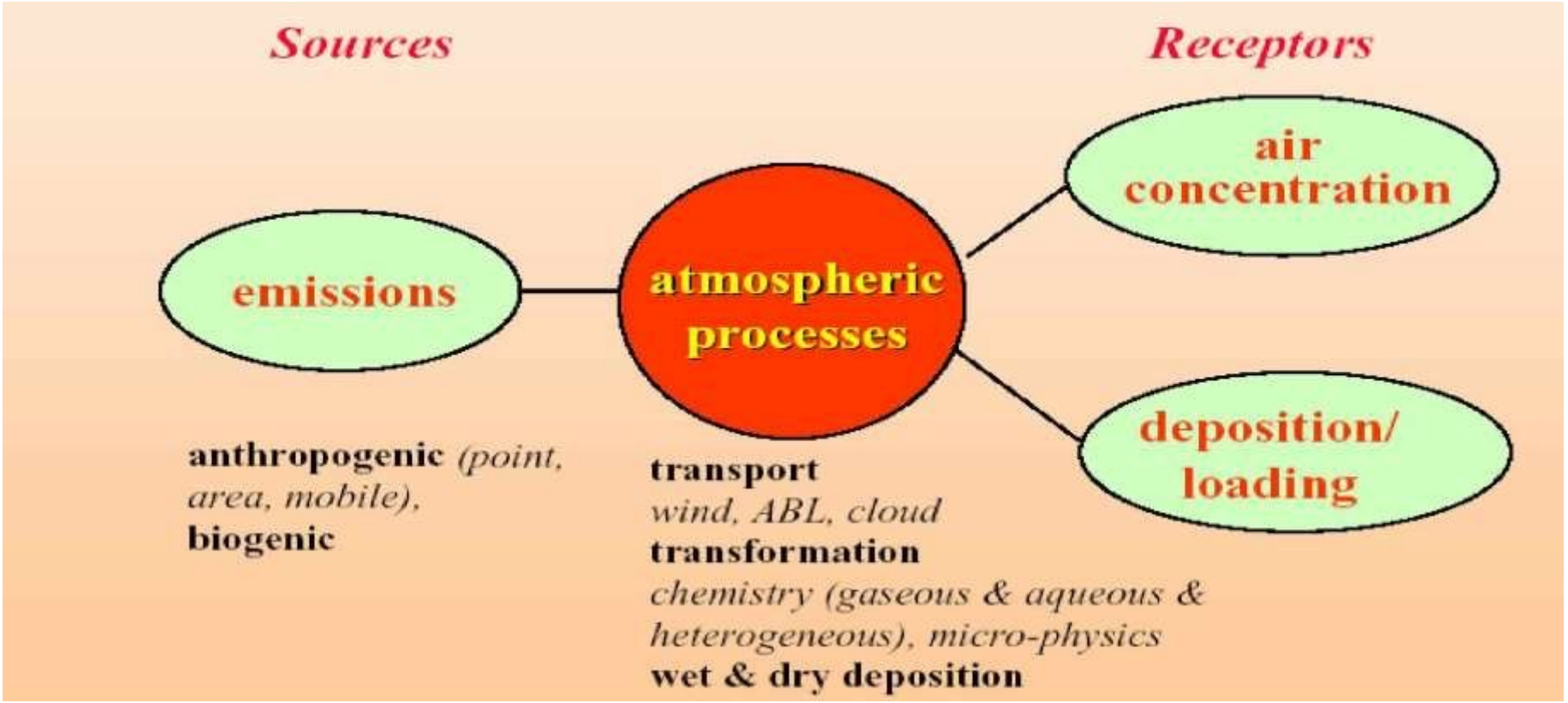
- Ambient environment monitoring includes:
  - Air Pollution Monitoring
  - Water Pollution Monitoring
  - Sediment, Soil and Biological Monitoring
  - Noise Level Monitoring

AIR POLLUTION MONITORING

AIR POLLUTION

Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or damages the natural environment into the atmosphere

AIR POLLUTION SYSTEM



1ST COMPONENT
SOUCES OF AIR POLLUTION – 1st Way

NATURAL SOURCES:

The natural sources of air pollution are also known as **Biogenic sources.** The natural pollution includes sources such as oceanic aerosol, volcanic emissions, forest fires, biological decay, windblown terrestrial dust and lightening.

ANTHROPOGENIC SOURCES:

The artificial pollution generates from human activities and includes sources such as fuel burning, refuge burning, transportation, construction of buildings, chemical factories, metallurgical factories and, vehicles.

Volcano activity

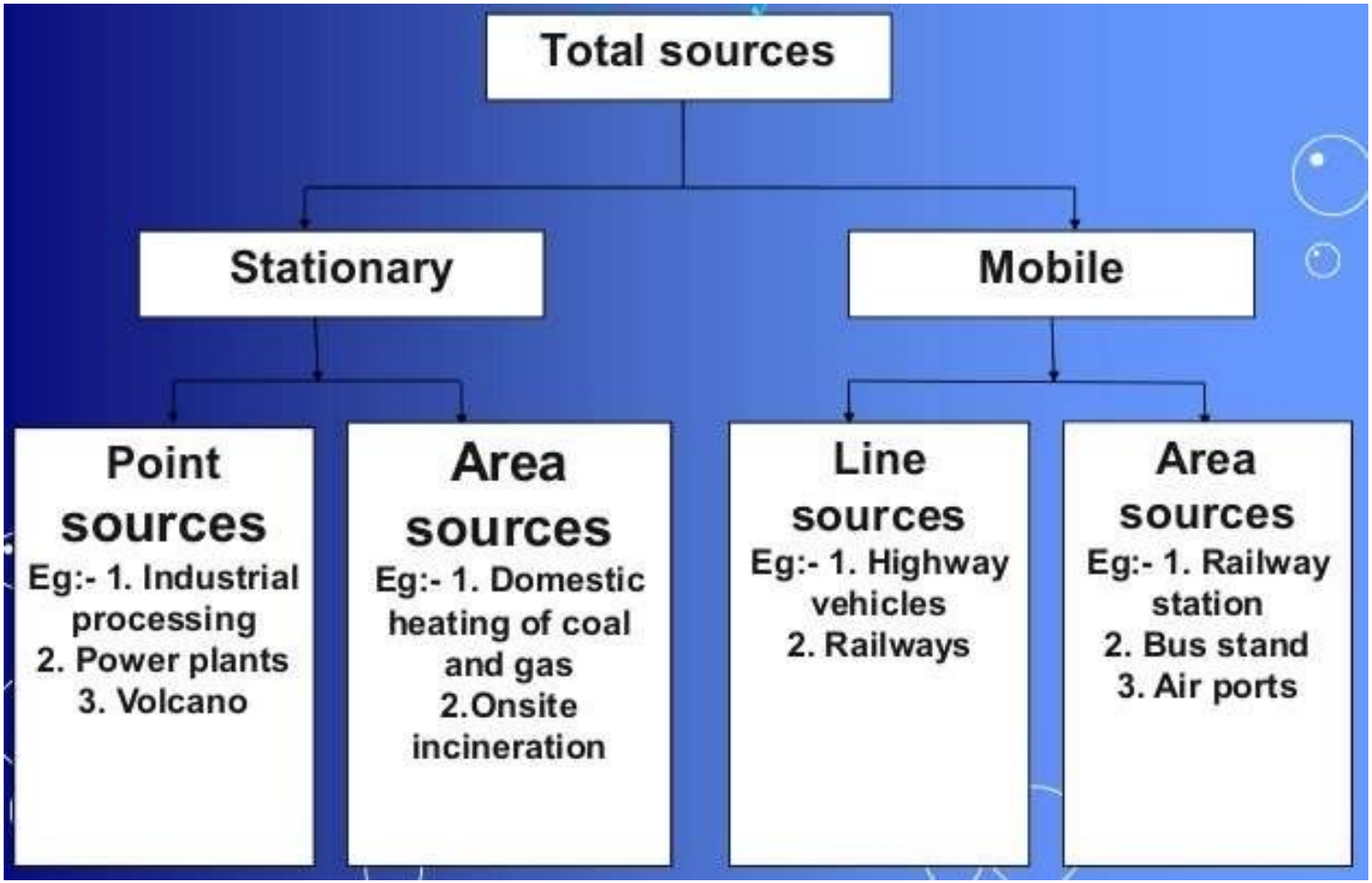
Landsat 7 Enhanced Thematic Mapper (ETM+) natural colour composite acquired on 13 February 2000 showing the active Kagoshima Volcano, Japan. There are many people living in close proximity to the volcano (top left) regardless the inconvenience of the high density of volcano ash and potential danger.

(Courtesy USGS)

Sandstorm

Meteorological satellite image showing a sandstorm swiping North China on 22 March 2010.

SOUCES OF AIR POLLUTION – 2nd Way



INDUSTRIAL EMISSION

BURNING FOSSIL FUELS

MINING OPERATIONS

2ND COMPONENT ATMOSPHERIC PROCESSES

- Atmospheric processes are responsible for transportation, mixing, physical and chemical transformation of pollutants. The wind speed and direction decide how quickly the pollutants will be dispersed and what will be the direction of impact. The vertical temperature profile of the atmosphere decide about the vertical mixing and turbulence in the atmosphere.

CLASSIFICATION OF AIR POLLUTANTS

PRIMARY POLLUTANTS (emitted directly to the atmosphere)

There are five primary pollutants that contribute to 90% of global air pollution.

1. Oxides of carbon like carbon monoxide and carbon dioxide (CO & CO2).
2. Oxides of nitrogen, like NO, NO_2, NO_3 (expressed as NOx).
3. Oxides of sulphur particularly sulphur dioxide (SO_2).
4. Volatile organic compounds, mostly hydrocarbons.
5. Suspended particulate matter (SPM): Aerosols.

SECONDARY AIR POLLUTANTS

The pollutants that are produced in the atmosphere, when certain chemical reactions take place among the primary pollutants and with others in the atmosphere are called **secondary air pollutants**.

1. Sulphuric acid
2. Nitric acid
3. Carbonic acid
4. Ozone
5. Formaldehydes
6. Peroxy-acyl-nitrate (PAN).

Air Pollutants & Sources

Nitrogen oxides

produced by petrol- or diesel-burning engines and coal/oil furnaces.

Carbon Monoxide

produced by the incomplete burning of carbon-containing fuels, such as petrol, coal and wood.

Ozone

produced by the reaction of oxygen gas with free atoms of oxygen which are formed from the reactions between nitrogen oxides and hydrocarbons in sunlight.

Major Air Pollutant

Sulphur dioxide

produced by burning of fossil fuels (e.g. fuel oil and coil). A large proportion is produced by power stations and metal smelters which burn sulphur-containing coal, and also by the manufacturing industries which burn fuel oil.

Particulates

produced by refuse incineration, factories, diesel vehicles, construction sites, and coal/charcoal burners. Particulates are solid or liquid particles which are so small that they remain suspended in the air for a long period of time.

Hydrocarbons

formed from the evaporation of materials such as petrol, diesel and solvents when exposed to air.

EFFECTS OF AIR POLLUTION

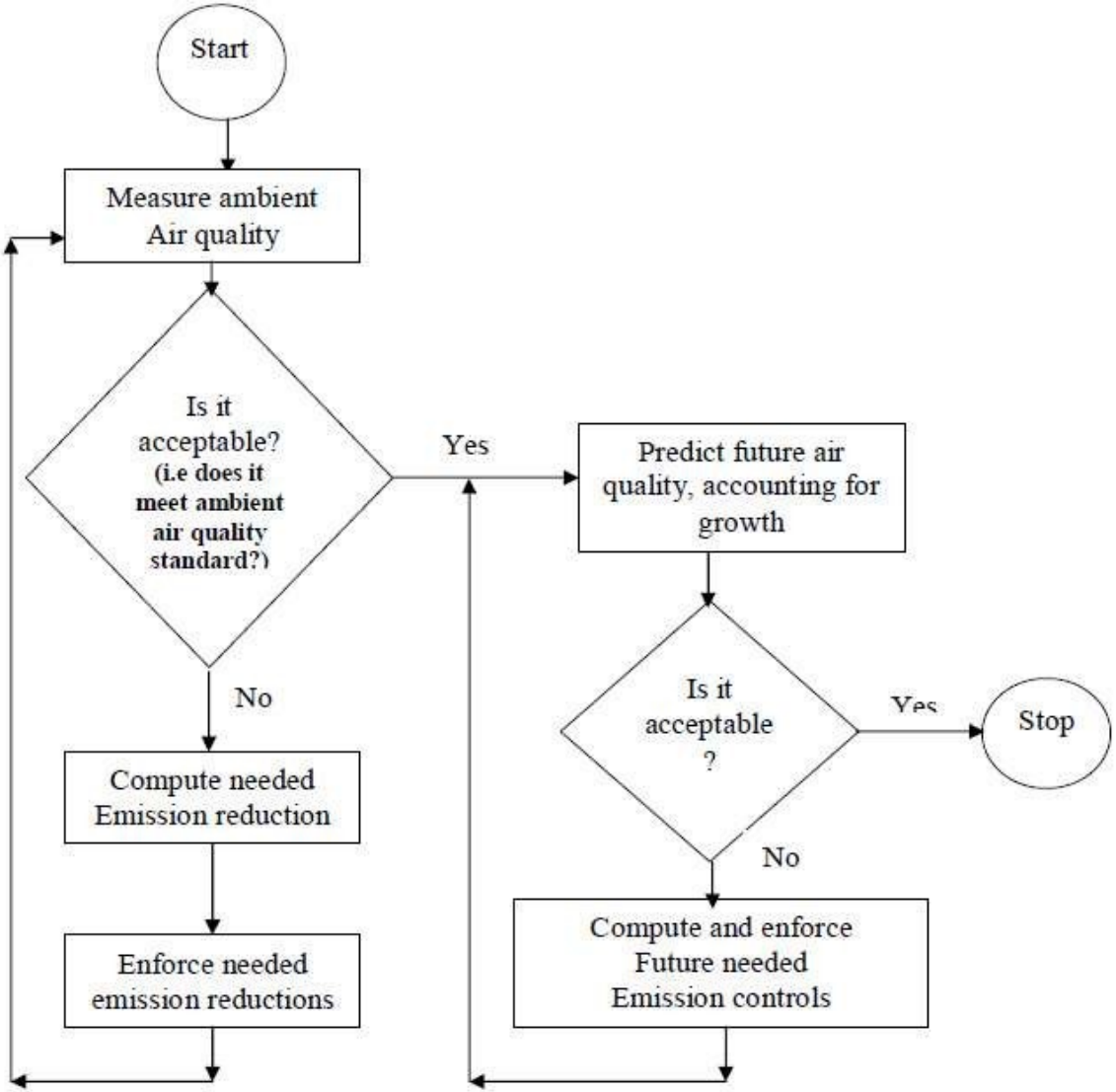
Effects on human health

- Irritation and inflammation
- Breathing difficulties
- Lung damage
- Heart disease
- Vision problems
- Premature death

Effects on natural environment

- Acid rain
- Ozone layer depletion
- Global warming
- Global climate change
- Photochemical Smog
- Reduction in visibility

Flow diagram representation of the National Ambient Air Quality Standard (also called Air Quality Management) process.



National Ambient Air Quality Monitoring Program

National Ambient Air Quality Standard Parameters

Manual Monitoring

SO_2, NO_2, PM_{10}, $PM_{2.5}$, O_3, NH_3, Benzene, BaP, Ni, As, Pb

Gravimetric

PM10 & PM2.5

Wet-chemical Methods

SO_2, NO_2, O_3, NH_3, Benzene

Sample Processing & Chemical Analyses

Benzene, B(a)P, Ni, As, Pb (in PM10)

Well established monitoring -cum-laboratory infrastructure, Trained man-power, Well established guidelines, manual data generation & dissemination etc.

Automatic Analyzers

SO2, NO2, PM10, PM2.5, O3, CO, NH3, Benzene

Sophisticated Analyzers, QA/QC, Instant Data Generation, On line data disseminations, Air Quality Index, Early Warning System, Forecasting, Modeling etc.

Site & Parameter Selection

Background & other areas(Rural, Semi-urban, Urban, Industrial, sensitive etc.)

Site Selection

- Away from source & other interferences (Inlet 15 m away from source / traffic artery)
- Height of inlet >3m (preferably 3-10m) Double the height of nearby wall / obstructed
- Free flowing, well mixed
- Elevation Angle <30 (from inlet to top of building)
- Collocated samplers should be 2 m apart

Parameter Selection

- Sensitive Location (SO2 & NO2)
- Health Impact Stations (All pollutants)
- Population & Exposure (All Criteria Pollutants)
- Kerb side (Traffic Intersection) (Criteria Pollutants + CO)
- Downtown (Accumulative, 50 m away traffic intersection) (Criteria Pollutants + O3)

IMPORTANCE OF SATELLITE IMAGERY IN MONITORING AIR QUALITY

- Satellite remote sensing provides complete and synoptic views of large areas in one image on a systematic basis due to the good temporal resolution of various satellite sensors.
- Satellite remote sensing can monitor many pollutants simultaneously.
- It has the capability to monitor in near real – time, and provides continuously rapid monitoring.
- The different satellites used in mapping air pollution are:
  - Earth resource satellites (Landsat, SPOT, ZY-3)
  - Meteorological satellites (NOAA satellites, GOES satellites)
  - Radar satellites (Seasat, ERS – 1,2 JERS – 1, Radarasat)

- It was the potential of images from space platform to track hurricanes and other weather systems that led to the first operational use of what we now call Earth Observation by remote sensing. In 1960, the U.S. NOAA (National Oceanic and Atmospheric Administration) launched the first civilian satellite specifically to photgraph the earth on a regular basis, in order to provide data for weather forecasting.

- This satellite called TIROS (Television Infrared Observation Satellite), was the first of the TIROS/NOAA weather satellite that provide daily images of the globe, those that are seen on our daily T.V. weather forecast.

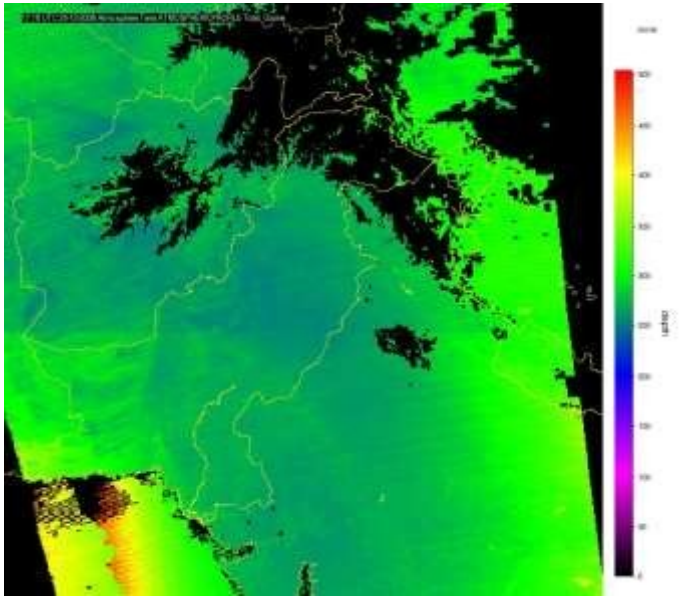
- Both polar-orbiting satellites such as NOAA and Geostationary satellites such as GOES and METEOSAT are used routinely nowadays for weather forecasting.

Figure 6. Hurricane Andrew over the Gulf of Mexico (1992). The coastline of the south-eastern USA is superimposed in red.

- The first applications of satellite remote sensing of aerosols used the AVHRR, Landsat, and GOES instruments to observe desert particles over ocean
- All three of them were used to obtain the information about aerosols primarily over water
- Satellite remote sensing of tropospheric trace gases began in 1978 with the launch of the TOMS instrument onboard the Nimbus 7 satellite
- TOMS instrument were aimed to determine stratospheric O3, volcanic SO2 ,tropospheric O3 , and ultraviolet absorbing aerosols .

Total Stratospheric Ozone through Satellite

- **Images from TIROS/NOAA weather satellites also contribute to public concern over the state of the environment.**



- Range:
  - 0 du to 500d

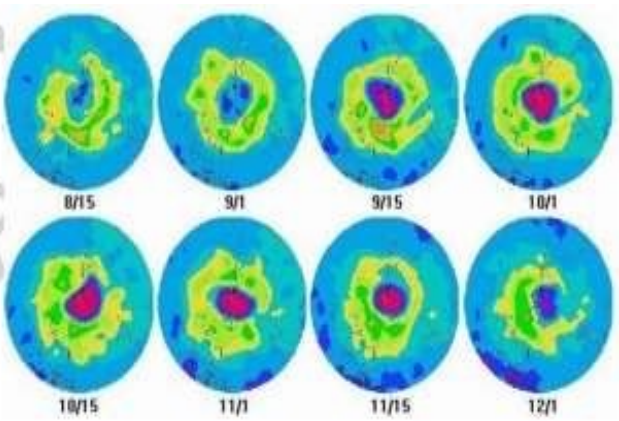


Figure 3. The "ozone hole" over the Antarctic for the period September–December 1995.
Red areas show severe depletion of up to 70% of normal values.
Images are from NOAA TOVS (TIROS operational vertical sounder) instrument.

Some International Weather Satellites (Geostationary)

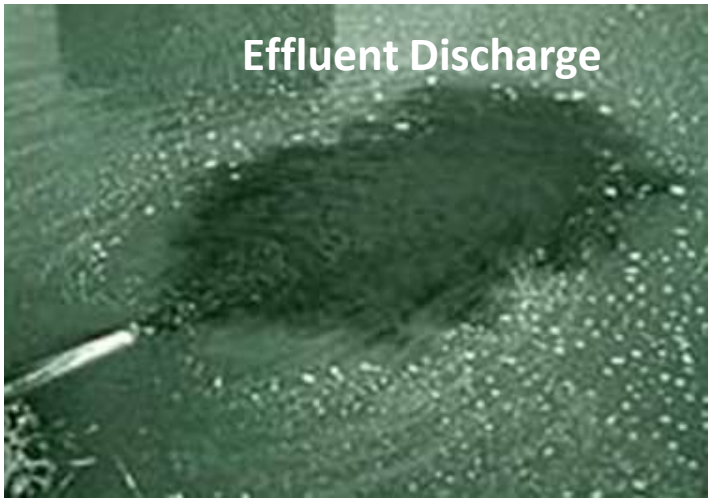
Name	Operator
METEOSAT, ERS, ENVISAT	European Space Agency
GMS	Japan
INSAT	India
Feng Yun	China
GOMS, METEOR	USSR
RADARSAT	Canada

WATER POLLUTION MONITORING

WATER POLLIUTION

Water quality is affected by materials delivered to a water body from either point or nonpoint sources.

1. **Point sources** can be traced to a single source, such as a pipe or a ditch.
2. **Nonpoint sources** are diffuse and associated with the landscape and its response to water movement, land use and management, and/or other human and natural activities on the watershed.



Agriculture, industrial, and urban areas are anthropogenic sources of point and nonpoint substances.

Major factors affecting water quality in water bodies across the landscape are suspended sediments (turbidity), algae (i.e., chlorophylls, carotenoids), chemicals (i.e., nutrients, pesticides, metals), dissolved organic matter (DOM), thermal releases, aquatic vascular plants, pathogens, and oils.

EFFECTS OF WATER POLLUTION

- Water borne diseases diarrhea, typhoid etc.
- Eutrophication
- ↑ organic matter ↓ dissolved oxygen (DO)
- Biomagnification
- High levels of organic chemicals (acids, salts& toxic metals) can make the water unfit to drink, harm fish and other aquatic life, reduce crop yields.
- Thermal pollution
- Heavy metal poisoning eg. Arsenic and Mercury poisoning of water.
- Sediments (Increase the turbidity of water)

SOURCE OF MONITORING

- Apart from the monitoring of pollutants in liquid effluents, sampling may be carried out.

(a) In rivers, lakes, estuaries and the sea in order to obtain an overall indication of water quality.

(b) For rain water, groundwater and run-off water particularly in the urban environment) to assess the influence of pollutant sources.

(c) At points where water is taken for supply, to cheek its suitability for a particular use.

(d) Using sediments and biological samples in order to assess the accumulation of pollutants and as indicators of pollution.

- Apart from the measurement of chemical and physical parameters the quantitative or qualitative assessment of aquatic flora and fauna is often used to give a holistic view of the presence or absence of pollution, and well recognized relationships exist between the abundance and diversity of species and the degree of pollution. This is often used to assess the cleanliness of natural fresh waters (biological monitoring).

WATER QUALITY PARAMETERS

- From the user's point of view, the term "water quality" is defined as "those physical, chemical or biological characteristics of water by which the user evaluates the acceptability of water.

- **PHYSICAL PARAMETERS** (solids, colour, temperature, turbidity, conductivity, density, odor and taste etc.)

- **CHEMICAL PARAMETERS** (BOD, DO, COD, pH, alkalinity, acidity, total organic carbon, phenols, pesticides, hardness, chloride etc.)

- **BIOLOGICAL PARAMETERS** (microorganisms: MPN count)

WATER QUALITY STANDARDS

- Water quality standards serve as the foundation for the water quality based approach to pollution control and are a fundamental component of water management.

- Water quality is a general descriptor of water properties in terms of physical, chemical, thermal, and/or biological characteristics. It is difficult to define a single water quality standard to meet all uses and user needs

- There are three categories ofstandards:

1. Streams standards
2. Effluent standards
3. Drinking water standards

WATER QUALITY CRITERIA

Box 4: Designated Best Use Classification of Surface water

Designated best use	Qual -ity Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliform organisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/l or more, and ➢ Biochemical Oxygen Demand 2 mg/l or less
Outdoor bathing (organized)	B	➢ Total coliform organisms(MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/l or less
Drinking water source with conventional treatment	C	➢ Total coliform organisms(MPN/100 ml) shall be 5000 or less ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/l or less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Free ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Aborption Ratio less than 26, and Boron less than 2 mg/l.

*** MPN: Most Probable Number**

(Source: CPCB, 1978)

REMOTE SENSING FOR WATER RESOURCE

The overall application of RS & GIS in water resources sector can be broadly categorized as below:

- Snow and Glacier mapping and monitoring
- Irrigation water management
- Flood disaster monitoring, forecasting and management
- Water quality monitoring
- Watershed management
- Groundwater prospecting
- Environmental Impact assessment

WATER QUALITY

- Substances (Suspended sediments, algae, dissolved organic matter (DOM), oils, aquatic vascular plants, and thermal releases) in surface water can significantly change the backscattering characteristics of surface water. Remote sensing techniques depend on the ability to measure these changes in the spectral signature backscattered from water and relate these measured changes by empirical or analytical models to a water quality parameter.

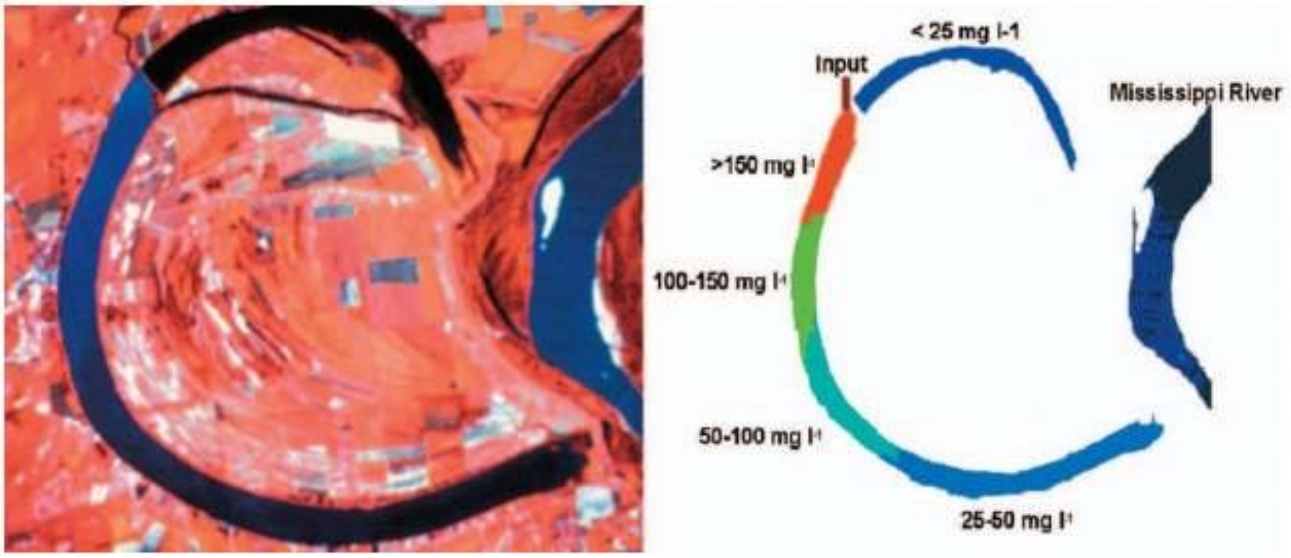


Plate 1. Landsat TM image of Lake Chicot, Arkansas (left) and a derived image (right) showing categories of suspended sediments mapped in Lake Chicot based on the radiance in the TM image.

Suspended Sediments

- Significant relationships between suspended sediments and radiance or reflectance from spectral wave bands or combinations of wave bands on satellite and aircraft sensors have been shown. Ritchie et al. (1976), using in situ studies, concluded that wavelengths between 700 and 800 nm were most useful for determining suspended sediments in surface water.

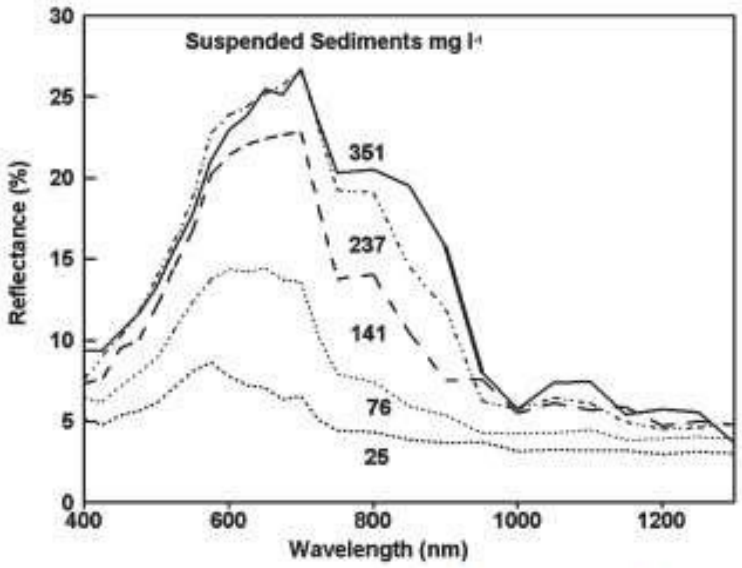


Figure 1. The relationship between reflectance and wavelength as affected by the concentration of suspended sediments (Ritchie *et al.*, 1976).

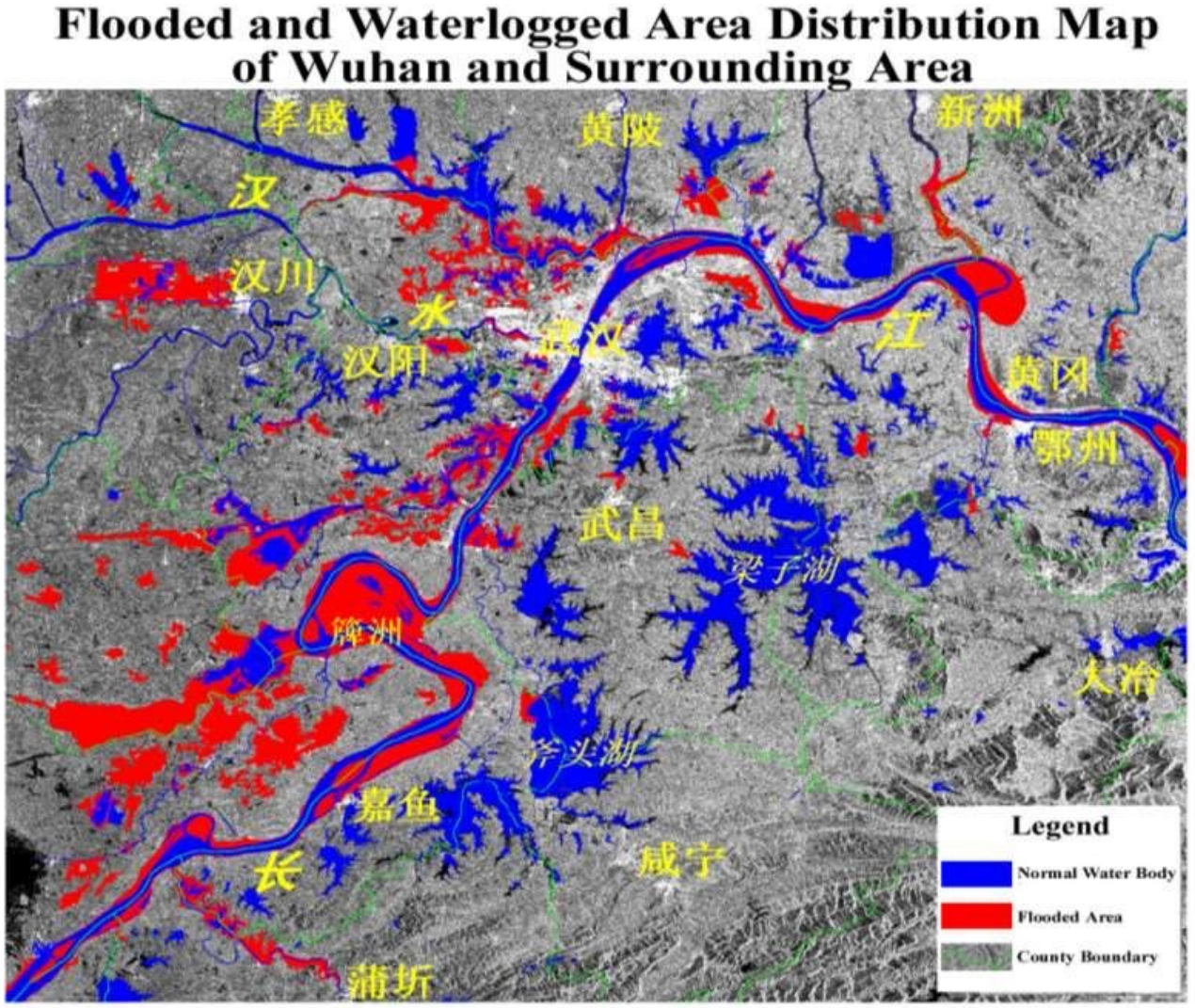
SNOW & GLACIER STUDIES

- The snow cover (build up and depletion) can be detected and monitored from a variety of remote sensing platforms.
- Glacier lakes are easily identifiable on multi-spectral satellite data of medium resolution (24-30m) to fine resolution (6m).
- Cloud and snow bound areas appear similar in standard FCC images, which is resolved through SWIR band response in which snow cover areas have low reflectance.
- Mazor sensors used for snow cover mapping are:
  - NOAA-AVHRR
  - MODIS – Aqua/Terra
  - Resourcesat 1 – AWiFS, LISSIII
  - Landsat – ETM
  - ASTER
  - SPOT

FLOOD MONITORING AND MANAGEMENT

Flood

Classified Radarsat (C-band) image for mid-reach of Yangtze River flooded area (near the city of Wuhan) on 22/8/1998.



FLOOD MANAGEMENT

Information required for disaster management:

S.No	PHASE	REQUIRED INFORMATION
1	Flood Preparedness (Before Flood)	• Chronically flood prone areas •Prior information on probable flood affected areas with considerable lead time. • Optimum evacuation plans
2.	Relief and Rescue (During Flood)	• Flood affected areas • Flood damage statistics •Updation of the flood condition in terms of flood recedence and persistence.
3.	Flood Mitigation (After Flood)	• Changes in the river course • River bank erosion • Drainage congestion • Flood risk zones

REMOTE SENSING FOR FLOODS

DURING PREPAREDNESS PHASE

- Using historic satellite remote sensing data acquired during floods, it is possible to provide the chronically flood prone areas in the form of a map showing severely affected, occasionally affected etc.
- Flood monitoring and forecast can be done using **hydrodynamic models.**

Hydrodynamic models:

- Landuse (IRS, SPOT, Landsat and IKONOS)
- Soil Type
- DEM (ERS, SPOT)
- Soil Moisture
- Rainfall (Meteorological satellites: GOES and POES, SAR, NOAA, AHVRR]
- Static data (eg. Drainage basin size)

- Using flood inundation models in GIS environment, optimum evacuation plan can be generated for carrying out rescue operations.

DURING FLOODS

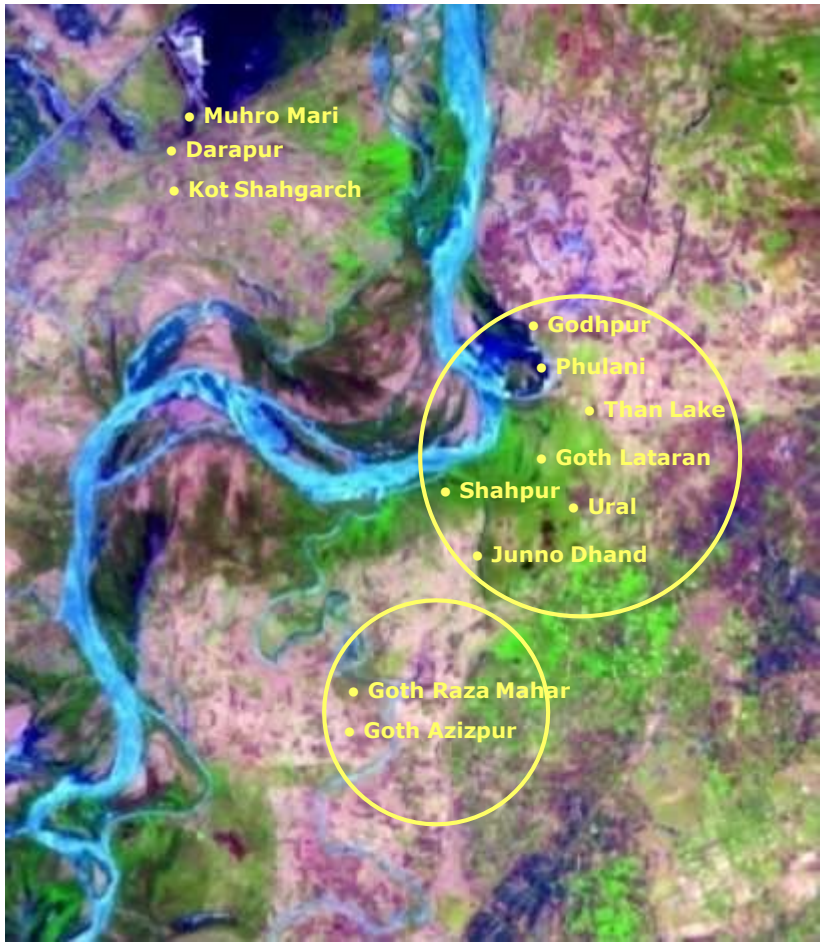
- A flood map showing the spatial extent of the flood affected area.
- Flood damage statistics like district wise flood affected area, submerged crop, marooned villages and length of submerged road/ rail can be provided.
- Satellite data can be used at regular intervals for updation of the flood condition (continuous flood monitoring).

DURING MITIGATION PHASE

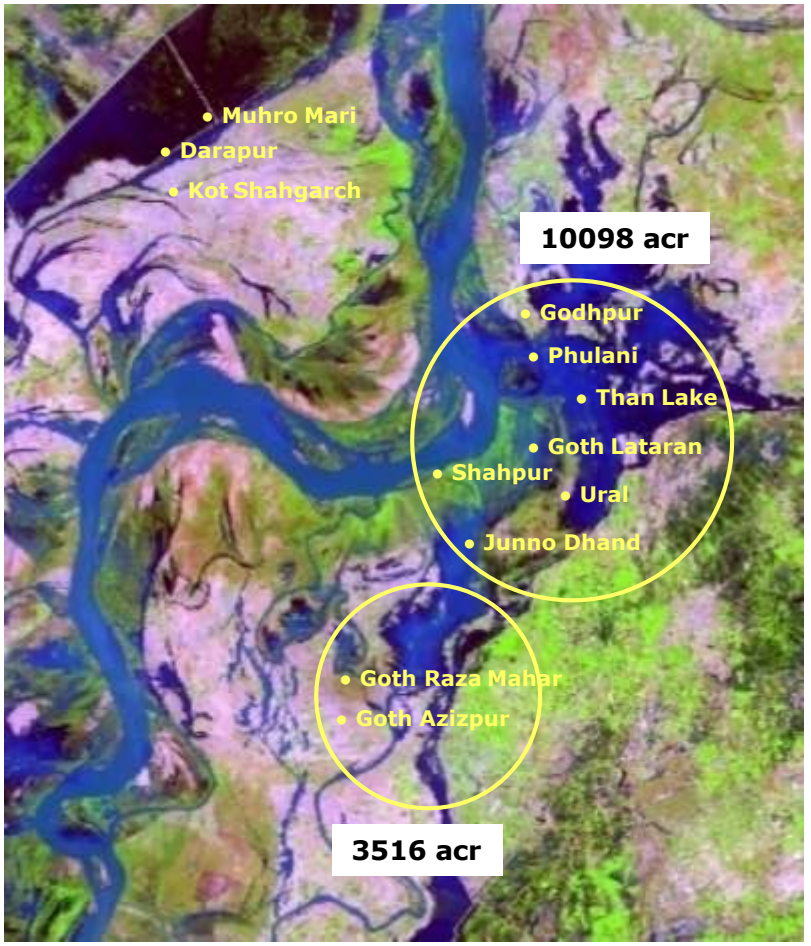
- Using high resolution historic and present satellite data, mapping of river configuration and flood control works, and studies of bank erosion can be carried out.
- Using multi-date satellite data it is possible to demarcate the drainage congestion areas in the chronic flood prone areas.
- Flood hazard and risk zone maps can be generated using multi – year satellite data acquired during floods.

Flood Damage to Standing Crops

Pre Flood – 17 July 2006



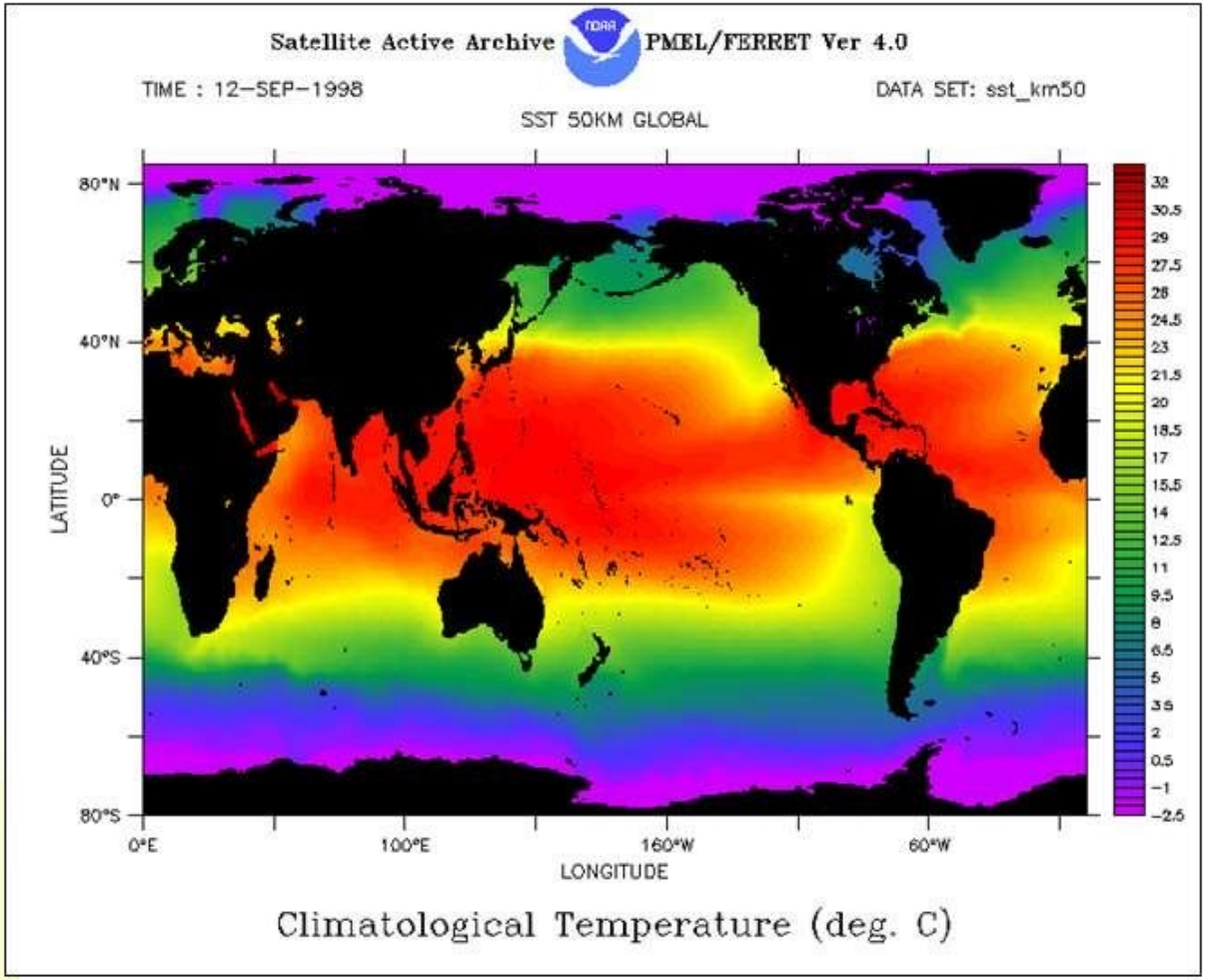
Post Flood – 09 Aug 2006



Ocean temperature

The global ocean temperature distribution by NOAA satellites.

(courtesy NOAA)



SOIL MONITORING

SOURCES OF SOIL POLLUTION

Soil may become polluted in a number of ways:

- Disposal of urban solid wastes
- Modern agricultural practices
- Disposal of industrial wastes overland
- Subsurface disposal of toxic wastes
- Deforestation leading to soil erosion
- Nuclear fallout and disposal of nuclear wastes
- Water logging and soil salinity
- Soil acidification
- Biological agents
- Other anthropogenic activities such as mining

Some potentially harmful substances such as mercury or lead are naturally present in soils but at concentration which are not normally deleterious. Some activities however can cause elevated levels of these compounds e.g. mining may cause soils to be contaminated by metals and the dumping of solid wastes in land will invariably introduce a wide variety of pollutants to the soil.

On the other hand there are compounds which do not occur naturally, and their presence in soils and sediments is due entirely to human activities. These substances include pesticides (particularly the organo-chlorine compounds such as DDT, aldrin, dieldrin)

EFFECTS OF SOIL/LAND POLLUTION

- Decrease in soil fertility and therefore decrease in crop yield.
- Modern agricultural practice results in physico – chemical and microbiological changes in the soil characteristics.
- **Ecological imbalance**: Disturbance in the balance of flora and fauna residing in the soil, due to alteration in the soil structure.
- Acid rain occurs when fumes released from industries get mixed with rain, which leads to acidification of soil.
- Waste that arises from the urban areas includes plastics, non-degradable compounds, enter the underground vegetables and affect human beings when present in large quantities.
- Radioactive isotopes (Strontium – 90 and Caesium – 137) remain in upper part of soil and are absorbed by plants like mushrooms, lichens etc. Thus may reach to human body and cause cancer, malformation of body at birth, organ abnormalities in the animals.

EFFECTS OF SOIL/LAND POLLUTION

- Chemical fertilizers, pesticides, fungicides, insecticides etc. may affect human being when present in large quantities. eg: - Nitrogen causes Blue Baby Syndrome.

- Biological agents like fungi, spores, toxins, bacteria etc. are passed into the soil by waste of animals and humans and causes diseases like cholera, typhoid, mycosis, tetanus etc.

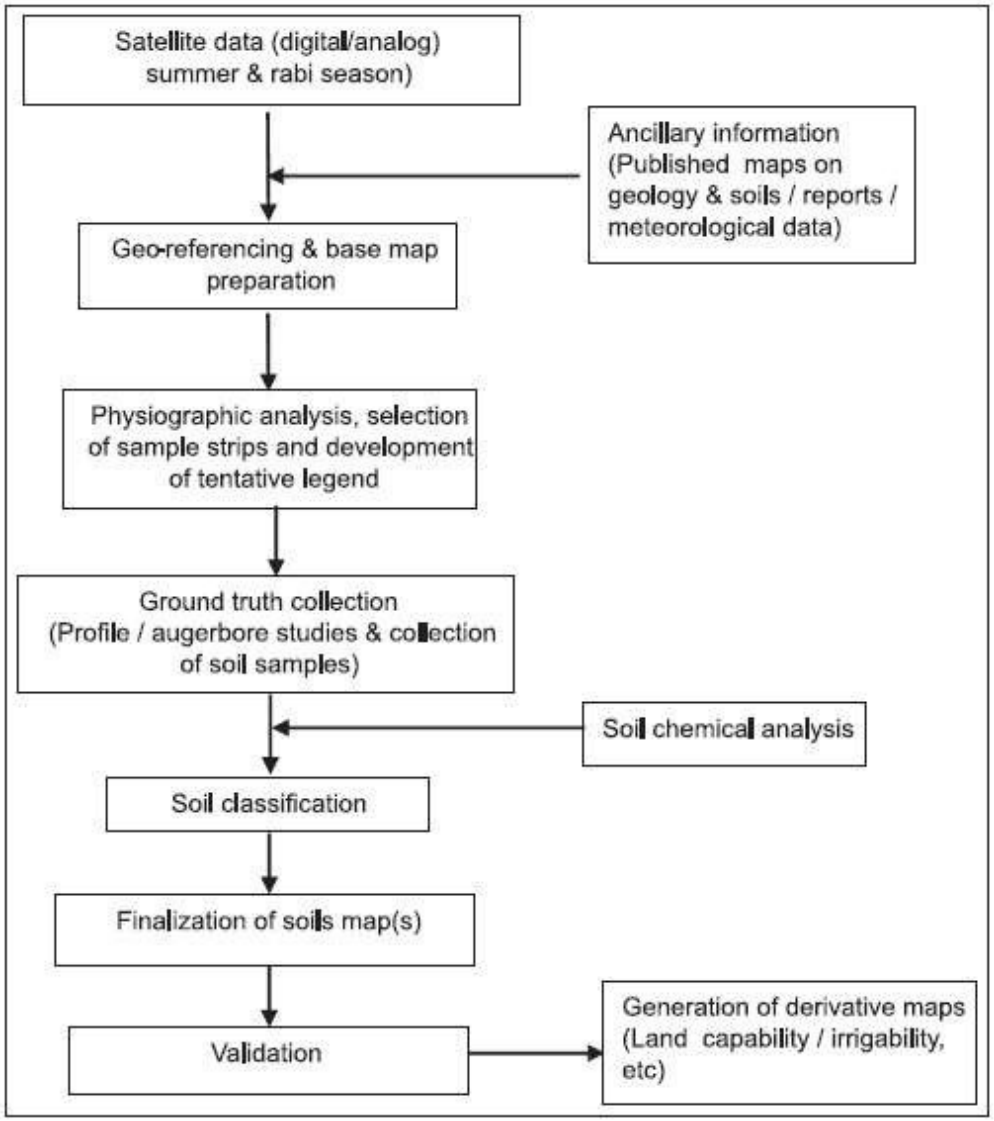
- Earthworms, hookworms, roundworms are also produced which affect the human health and appetite.

- Toxic substances from these dumps leach out and percolate through the soil layers below to contaminate the groundwater.

REMOTE SENSING IN SOIL MAPPING

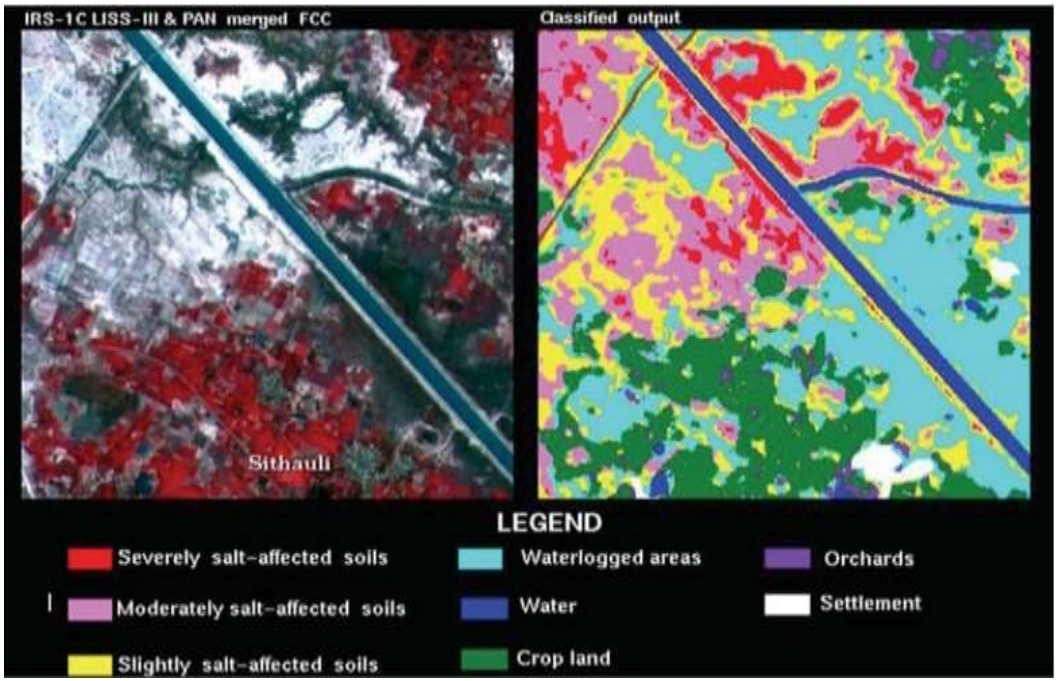
- Remote sensing technique has reduced fieldwork to a considerable extent and soil boundaries are more precisely delineated than in conventional methods.
- While mapping the soil using RS , the stereo data is highly useful in identification of different landforms, which have got close relationship with soils associated with them.
- The stereo data from PAN cameras aboard SPOT/ IRS – 1C/ Cartosat – 1 enabled the delineation of physiographic units and soil maps derived there from in a betterway.

Flowchart for soil mapping



SALINITY AND WATER LOGGED AREA MAPPING AND MONITORING

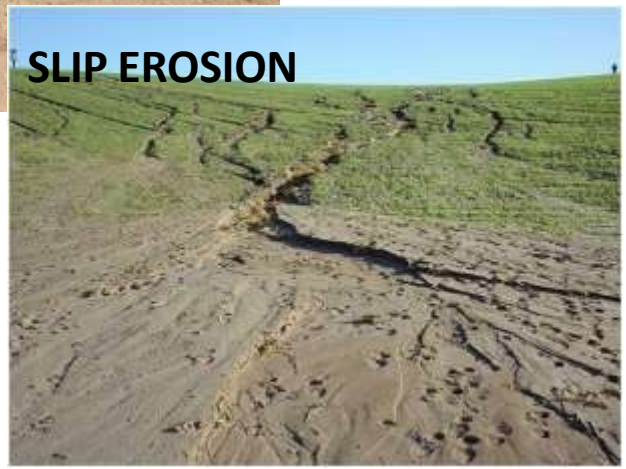
- Due to improper management of soil and water resources in the command areas, the problem of salinity and water logging are reported to be on the increase.
- Information on the nature, extent, spatial distribution and temporal behaviour of areas under water logging and salinity is essential for proper management of irrigated lands.



Sensors used are:
Landsat – MSS, TM
IRS – LISS – I/II/III
Resourcesat – 1
SPOT

SOIL EROSION

- Soil erosion is the process of removal of superficial layer of the soil from one place to another.



UNIVERSAL SOIL LOSS EQUATION (USLE)

- The USLE, developed by ARS scientists W. Wischmeier and D. Smith, has been the most widely accepted and utilized soil loss equation for over 30 years. Designed as a method to predict average annual soil loss caused by sheet and rill erosion. The USLE for estimating average annual soil erosion is:

$$A = RKLSCP$$

Where:

- **A** = average annual soil loss in t/a (tons per acre)
- **R** = rainfall erosivity index (Calculated from annual summation of rainfall energy)
- **K** = soil erodibility factor (This factor quantifies the cohesive, or bonding character of a soil type and its resistance to dislodging and transport due to raindrop impact and overland flow.)
- **LS** = topographic factor - L is for slope length & S is for slope
- **C** = cropping factor
- **P** = conservation practice factor (Practices included in this term are contouring, strip cropping and terracing)

ROLE OF REMOTE SENSING IN LANDSLIDE MAPPING

- Comprehensive landslide inventory is aprerequisite for landslide hazard and risk analysis.
- A landslide inventory map not only shows the time and date of occurrence but also the types of landslide.
- Landslide inventory involves:
  - Landslide distribution analysis
  - Landslide activity analysis

Landuse and land cover change

Landsat TM images acquired in 1988 and 1998 showing the dramatic landuse change in Dongguan City at eastern Pearl River Delta. Note the industrial belt from Humen to Dongguan shown on the 1998 image did not exist at all on the image acquired 10 years ago.

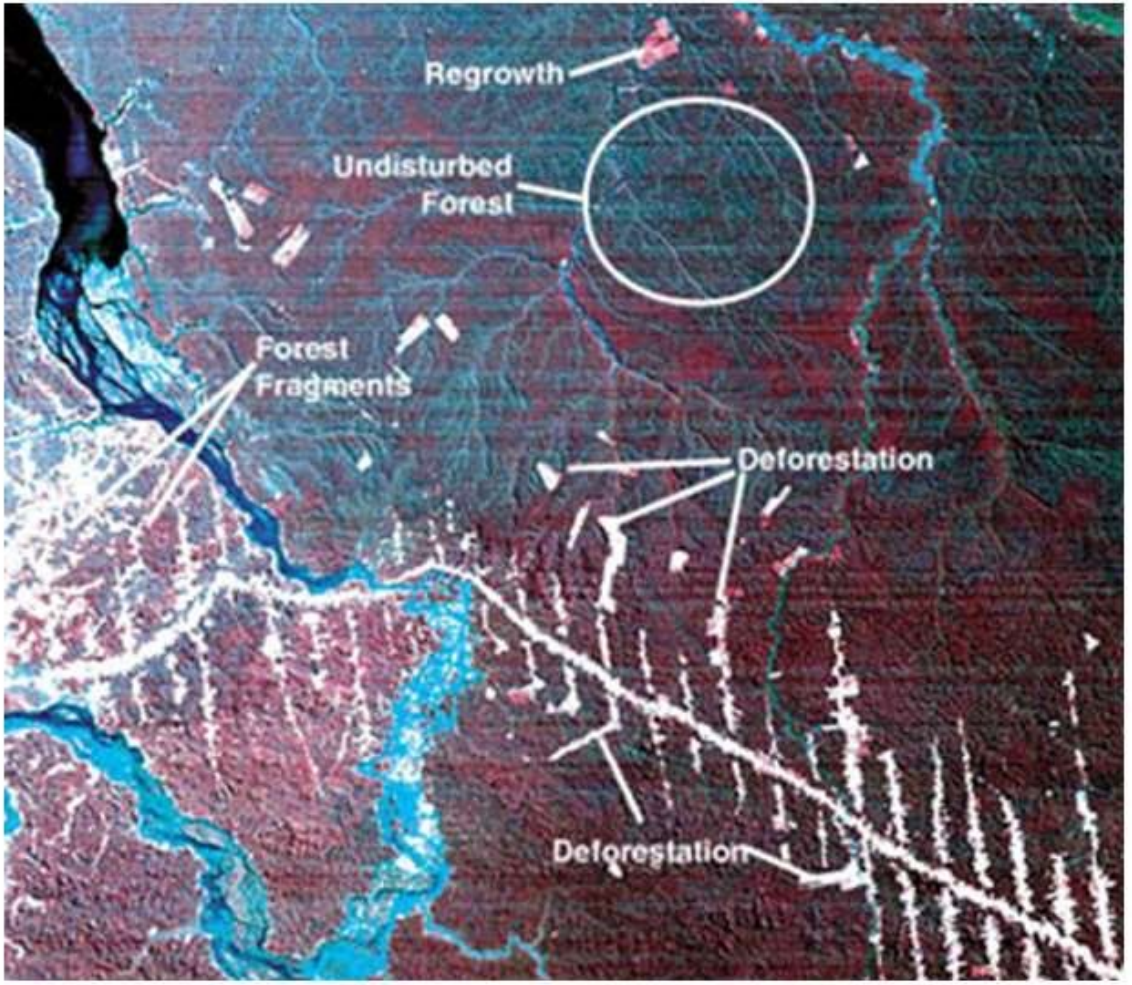
1988

1998

Deforestation

Landsat image showing deforestation in the Amazon region, taken from the Brazilian state of Para on 15 July 1986. The dark areas are forest, the white is deforested areas, and the grey is re-growth. The pattern of deforestation spreading along roads is obvious (lower part of the image).

(courtesy terra.nasa.gov)



NOISE POLLUTION

NOISE POLLUTION

- Noise is defined as unpleasant or disagreeable loud sound, or sound without value that causes discomfort to the listener.
- Any sound with loudness above than 80dB is consider Noise.

Sources of Noise Pollution

1. NATURAL

   Thunder, Earthquake

2. MAN –MADE

   a) Industrial – Machines, Construction Equipments

   b)Non- Industrial – Automobiles, Aircraft, generators, Markets, Loud speakers, Railway Stations.

EFFECTS OF NOISE POLLUTION

1. Auditory effects

- These include auditory fatigue and deafness. It appears in 90dB and may be associated with side effects as whistling or buzzing in ears (Temporary threshold shift (TTS)).
- Permanent loss of hearing occurs at loudness more than 100 dB (Noise Induced Permanent Threshold Shift (NIPTS)).
- More than 180 dB – Death of the person.

2. Non - auditory effects

- Interference with speech communication
- Annoyance
- Loss of working efficiency
- Physiological Disorder (Increase in BP / hypertension, Increased stress, Fatigue, Headache, Sleep disturbance/insomnia, anxiety, cardiovascular issues).

CONTROL OF NOISE POLLUTION

- **Source Control**

It may be achieved by designing silencing devices.

- **Transmission Control** (Sound Proofing)

Covering the room walls with sound absorbers as acoustic tiles.

- **Protection to exposed person**

Ear Plugs and Ear Muffs

- **Creation of vegetation buffer zone**

Plant absorb and dissipate sound energy and thus act as buffer zone.

- **Through Law**

  Silence zones could be created near important areas like school, hospital zones and to prevent indiscriminate use of loud speakers at public places.

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note:- 1. Day time shall mean from 6.00 a.m. to 10.00 p.m.

2. Night time shall mean from 10.00 p.m. to 6.00 a.m.

3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority

4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

"Save earth to bring worth for the new birth"