

Application of Remote sensing in coastal zone management

Dept of AEM

Course: AEM 503

Presented by : Tade Mayur S

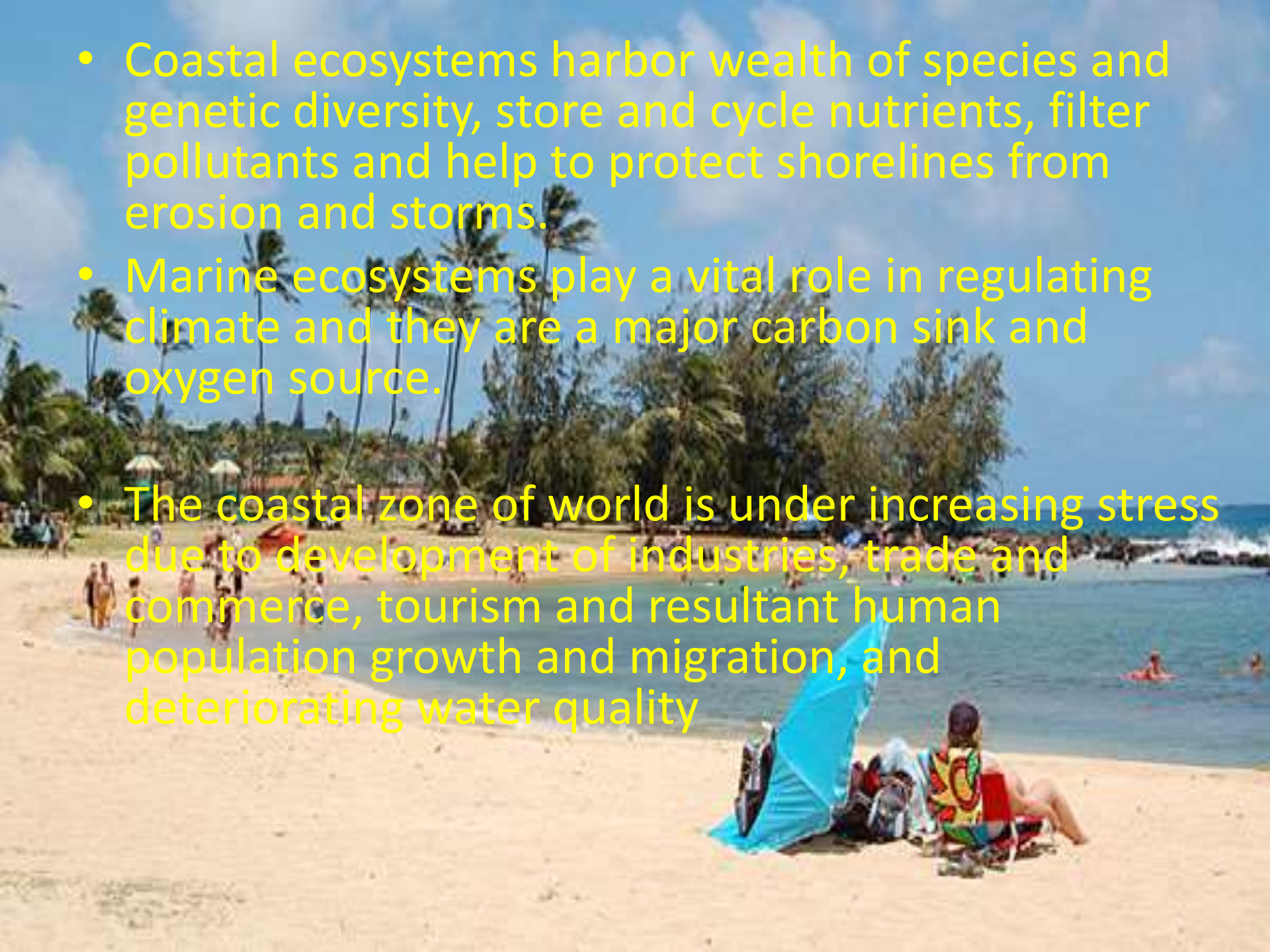
Outline of seminar

- Introduction of Coastal zone area
- Concept of remote sensing
- Electromagnetic spectrum
- What is Geographical information system(GIS)
- Application of remote sensing in coastal zone management

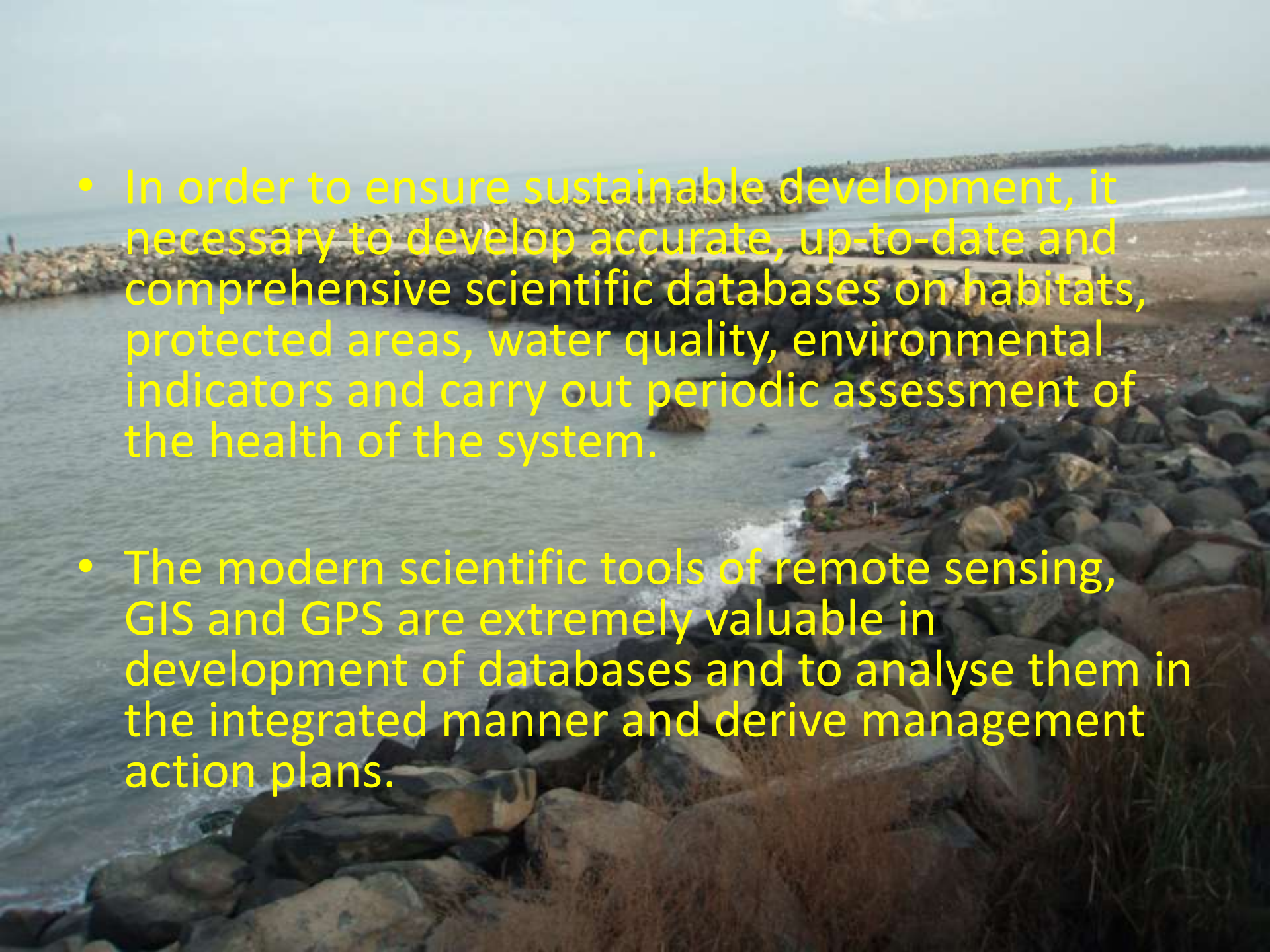
Introduction

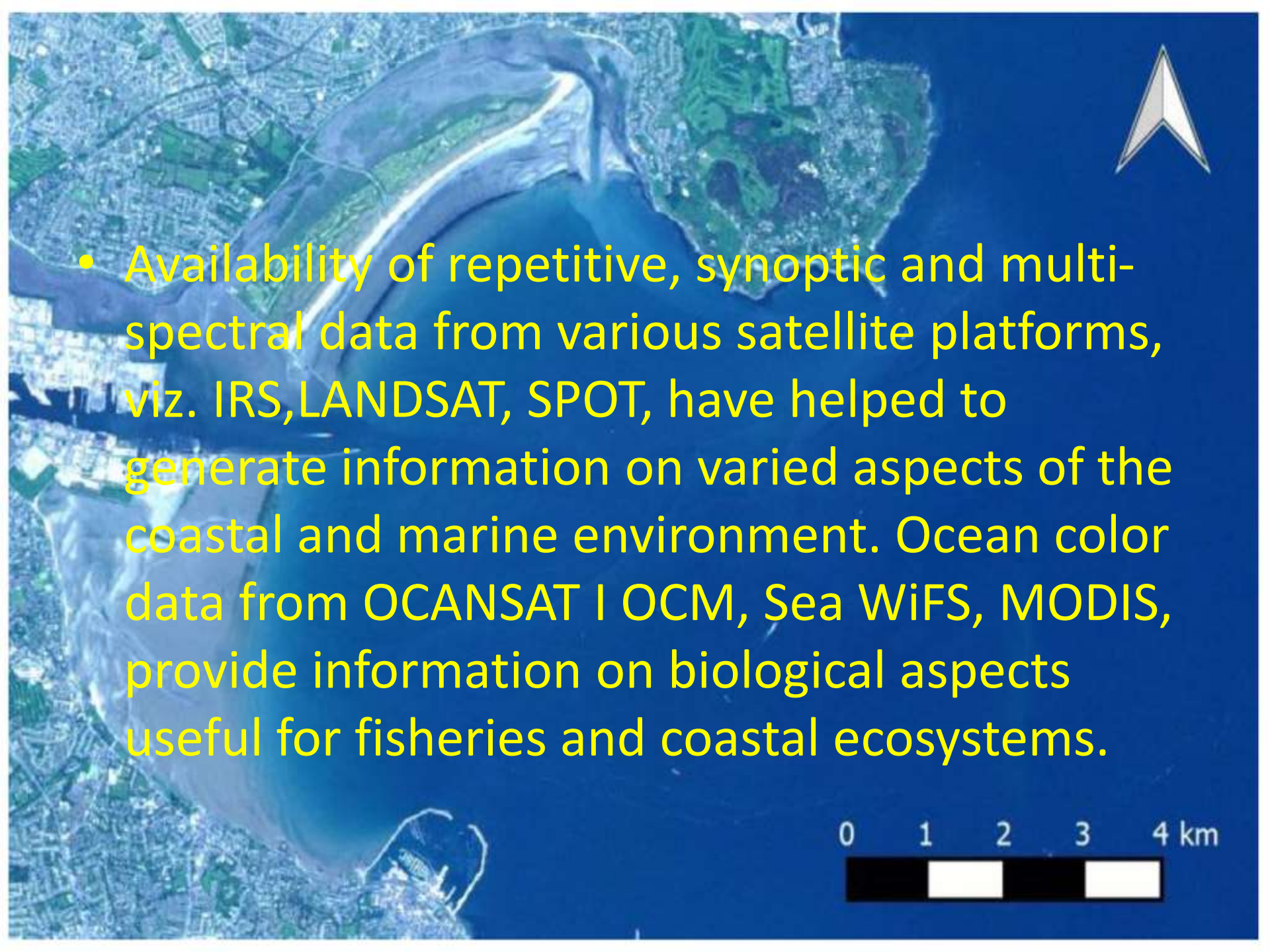
- Coastal zone are the area at the interface between land and sea, where the sea influences the land, and vice versa.
- it include intertidal habitats (mangroves, marshes, mud flats, rocky shores, sandy beaches), semi-enclosed bodies of water (estuaries, bays, fjords, gulfs, seas), benthic habitats (coral reefs, sea grass beds, kelp forests, hard and soft bottoms) and
- The open waters of the coastal ocean to the seaward limits of the Exclusive Economic Zone (EEZ), i.e. from the head of the tidal waters to the outer limits of the EEZ.

- Coastal ecosystems harbor wealth of species and genetic diversity, store and cycle nutrients, filter pollutants and help to protect shorelines from erosion and storms.
- Marine ecosystems play a vital role in regulating climate and they are a major carbon sink and oxygen source.
- The coastal zone of world is under increasing stress due to development of industries, trade and commerce, tourism and resultant human population growth and migration, and deteriorating water quality




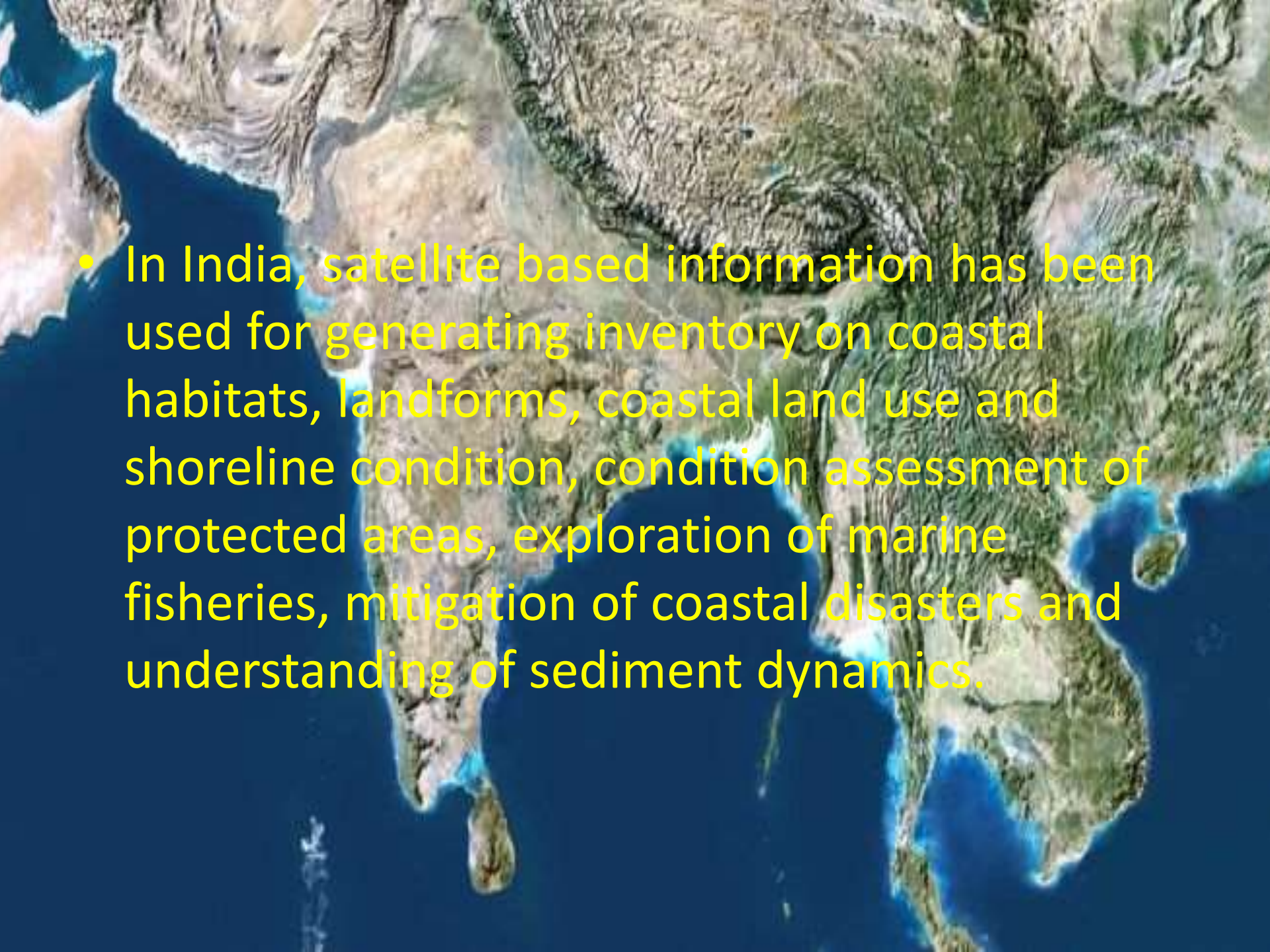
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- A photograph of a beach heavily littered with plastic waste, including bottles, caps, and debris, under a sunset sky. The foreground is dominated by a large pile of trash, including a clear plastic water bottle, a blue cap, and various pieces of plastic and wood. The beach extends into the distance, with the ocean visible on the right and a line of trees on the left. The sky is a mix of orange and blue, indicating sunset or sunrise.
- The industrial development of coast has resulted in degradation of coastal ecosystems and diminishing the living resources of Exclusive Economic Zone (EEZ) in form of coastal and marine biodiversity and productivity.

- 
- In order to ensure sustainable development, it is necessary to develop accurate, up-to-date and comprehensive scientific databases on habitats, protected areas, water quality, environmental indicators and carry out periodic assessment of the health of the system.
 - The modern scientific tools of remote sensing, GIS and GPS are extremely valuable in development of databases and to analyse them in an integrated manner and derive management action plans.

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- A satellite image of a coastal region, likely a bay or estuary, showing a mix of urban development, green spaces, and water bodies. The water in the bay is a deep blue, while the surrounding land is a mix of green and grey. A scale bar at the bottom right indicates a distance of 4 km. A north arrow is located in the top right corner.
- Availability of repetitive, synoptic and multi-spectral data from various satellite platforms, viz. IRS, LANDSAT, SPOT, have helped to generate information on varied aspects of the coastal and marine environment. Ocean color data from OCANSAT I OCM, Sea WiFS, MODIS, provide information on biological aspects useful for fisheries and coastal ecosystems.

0 1 2 3 4 km



- 
- A satellite-style map of the Indian subcontinent and surrounding regions, including parts of Pakistan, Bangladesh, and Southeast Asia. The map shows topographical features like mountains and rivers, as well as coastal areas. The text is overlaid on the left side of the map.
- In India, satellite based information has been used for generating inventory on coastal habitats, landforms, coastal land use and shoreline condition, condition assessment of protected areas, exploration of marine fisheries, mitigation of coastal disasters and understanding of sediment dynamics.

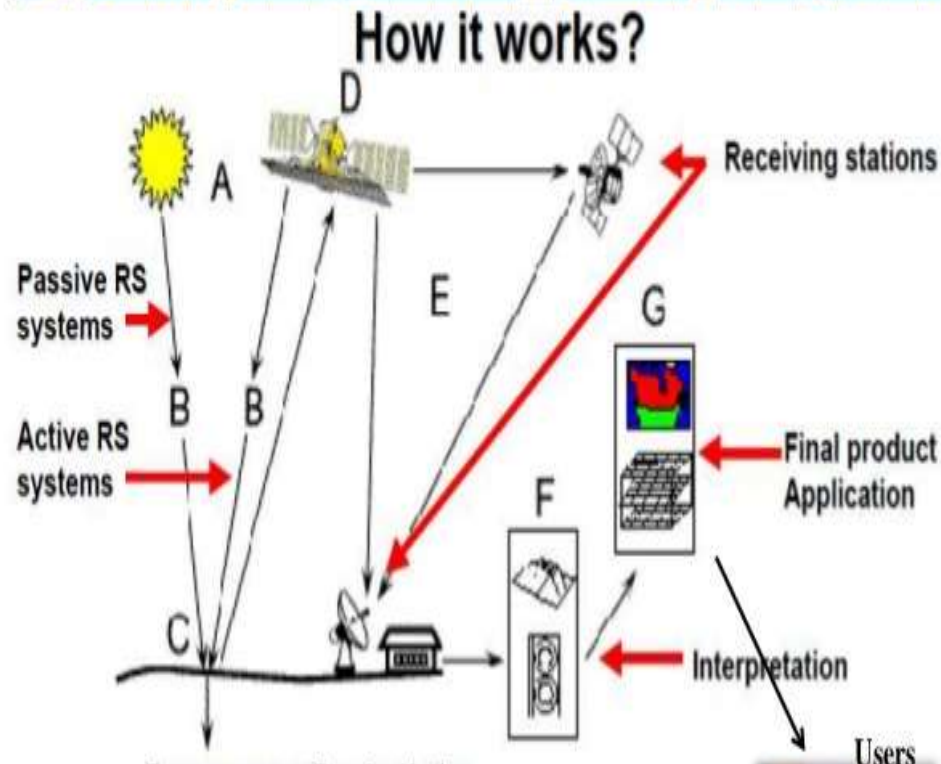
Concept of Remote sensing

A satellite with two large solar panel arrays is shown in space, orbiting the Earth. The Earth is visible in the background, showing blue oceans and green and brown landmasses. The satellite is gold-colored with various instruments and antennas.

"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.



- **Energy Source or Illumination (A)** – the first requirement for remote sensing is to have an energy source which illuminates or provides electromagnetic energy to the target of interest.

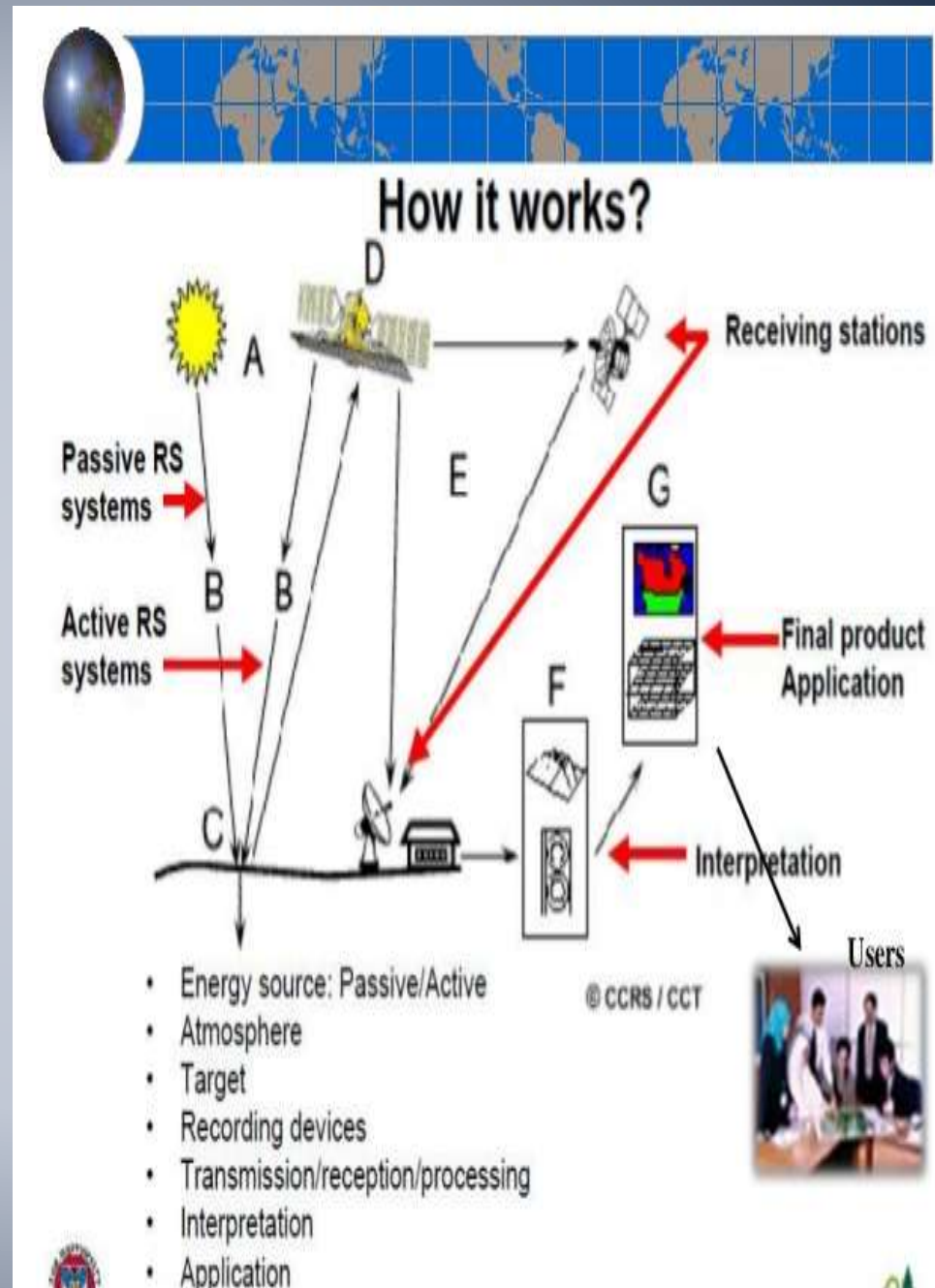


- Energy source: Passive/Active
- Atmosphere
- Target
- Recording devices
- Transmission/reception/processing
- Interpretation
- Application

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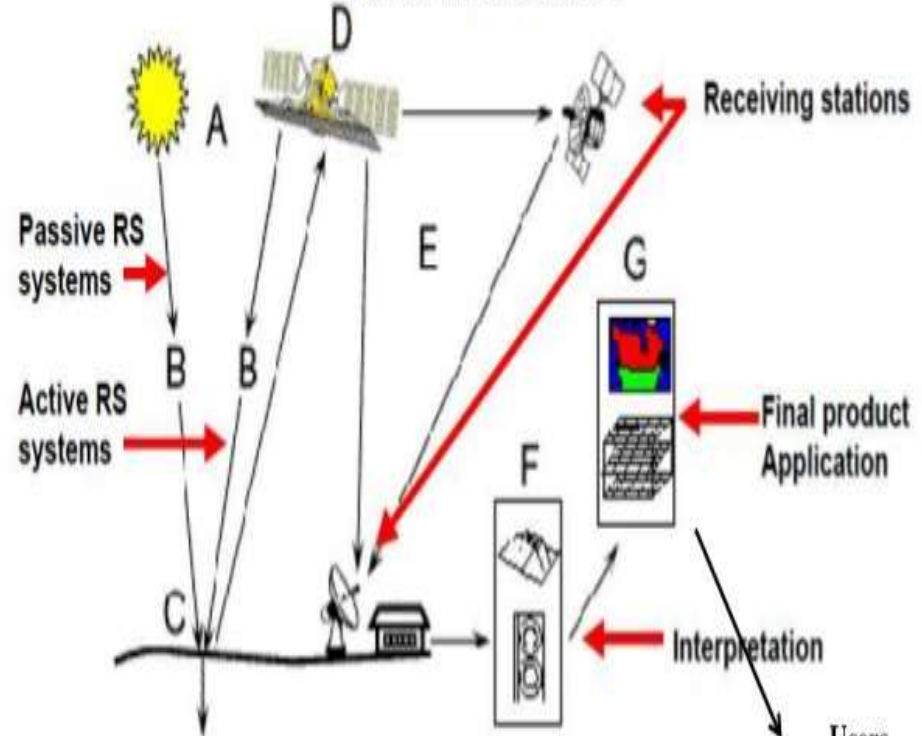
- **Radiation and the Atmosphere (B)** – as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This interaction may take place a second time as the energy travels from the target to the sensor.



- Interaction with the Target (C) - once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.
- radiation.



How it works?

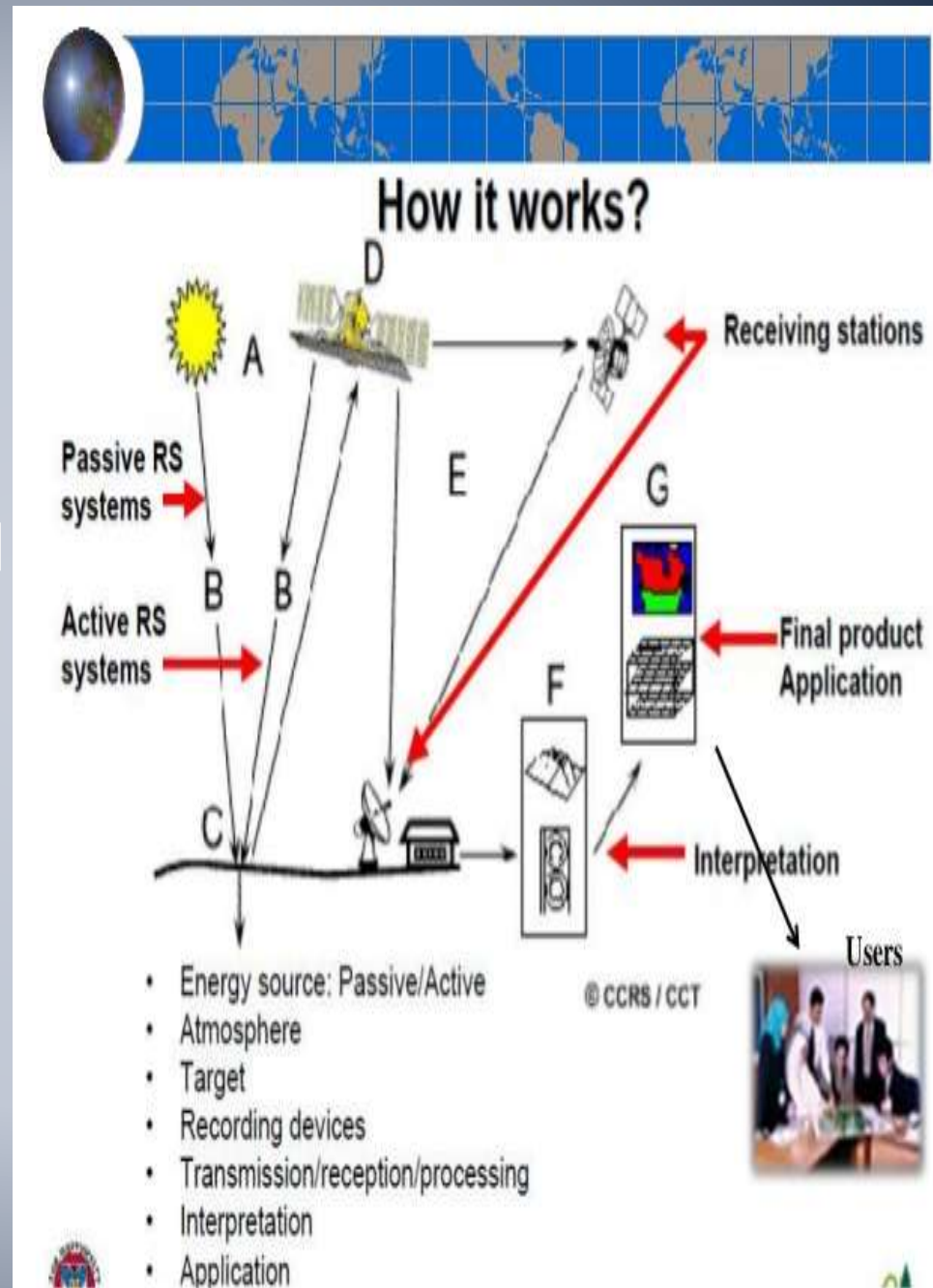


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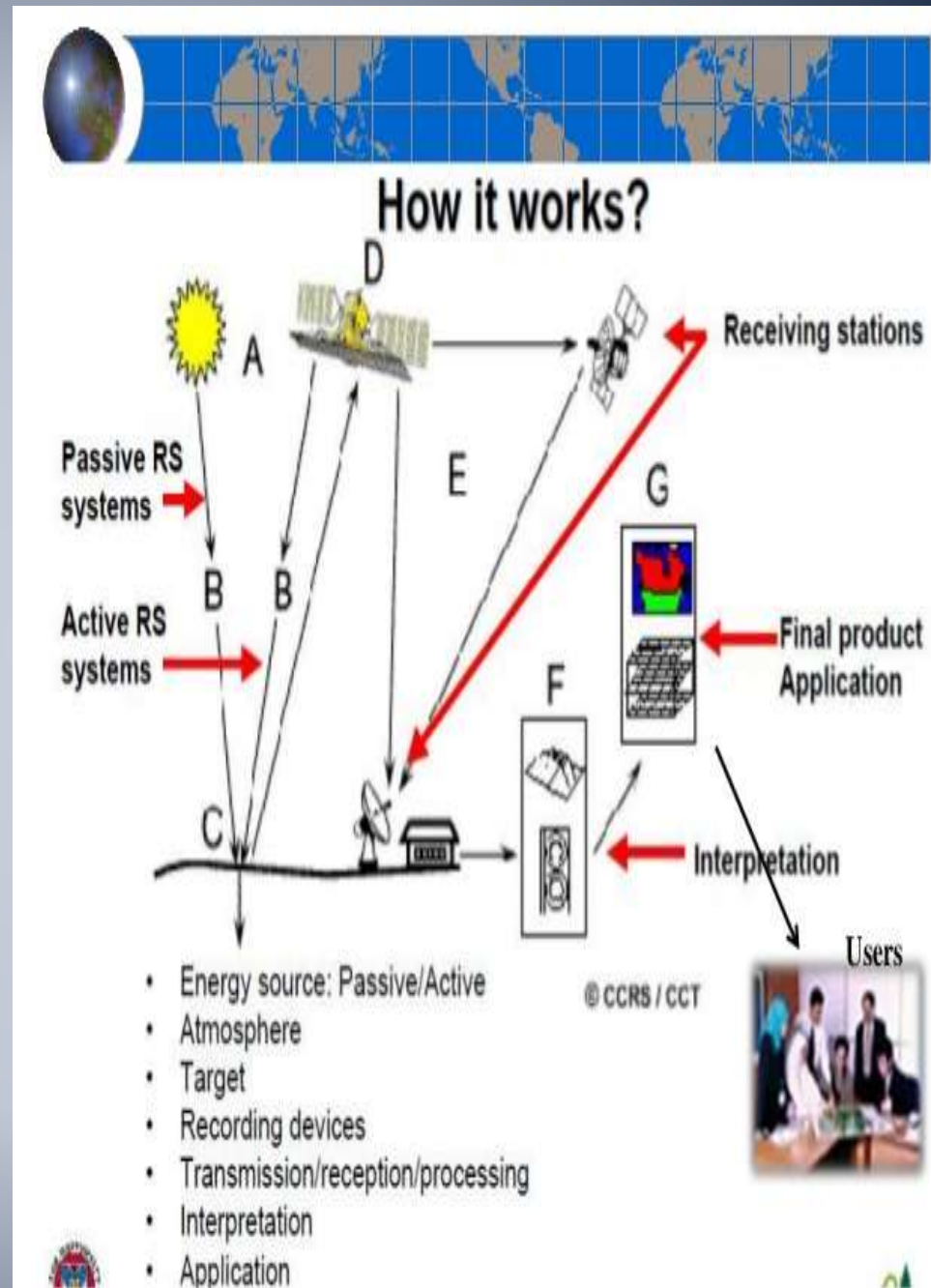
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- Recording of Energy by the Sensor (D) - after the energy has been scattered by, or emitted from the target, we require a sensor (remote - not in contact with the target) to collect and record the electromagnetic radiation.



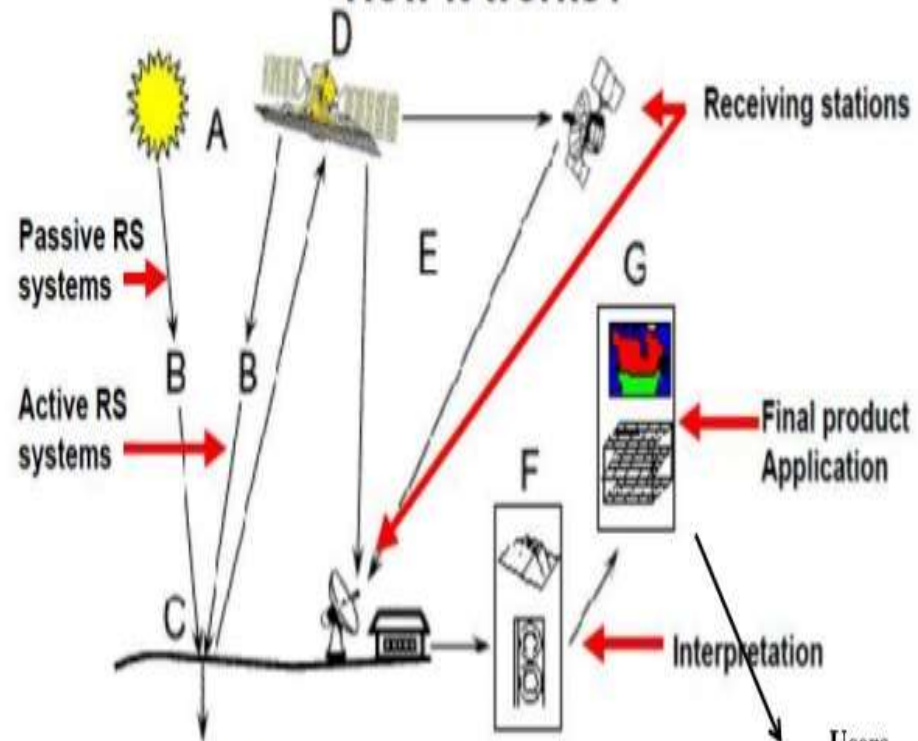
- **Transmission, Reception, and Processing (E) - the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).**



- Interpretation and Analysis (F) - the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated.



How it works?

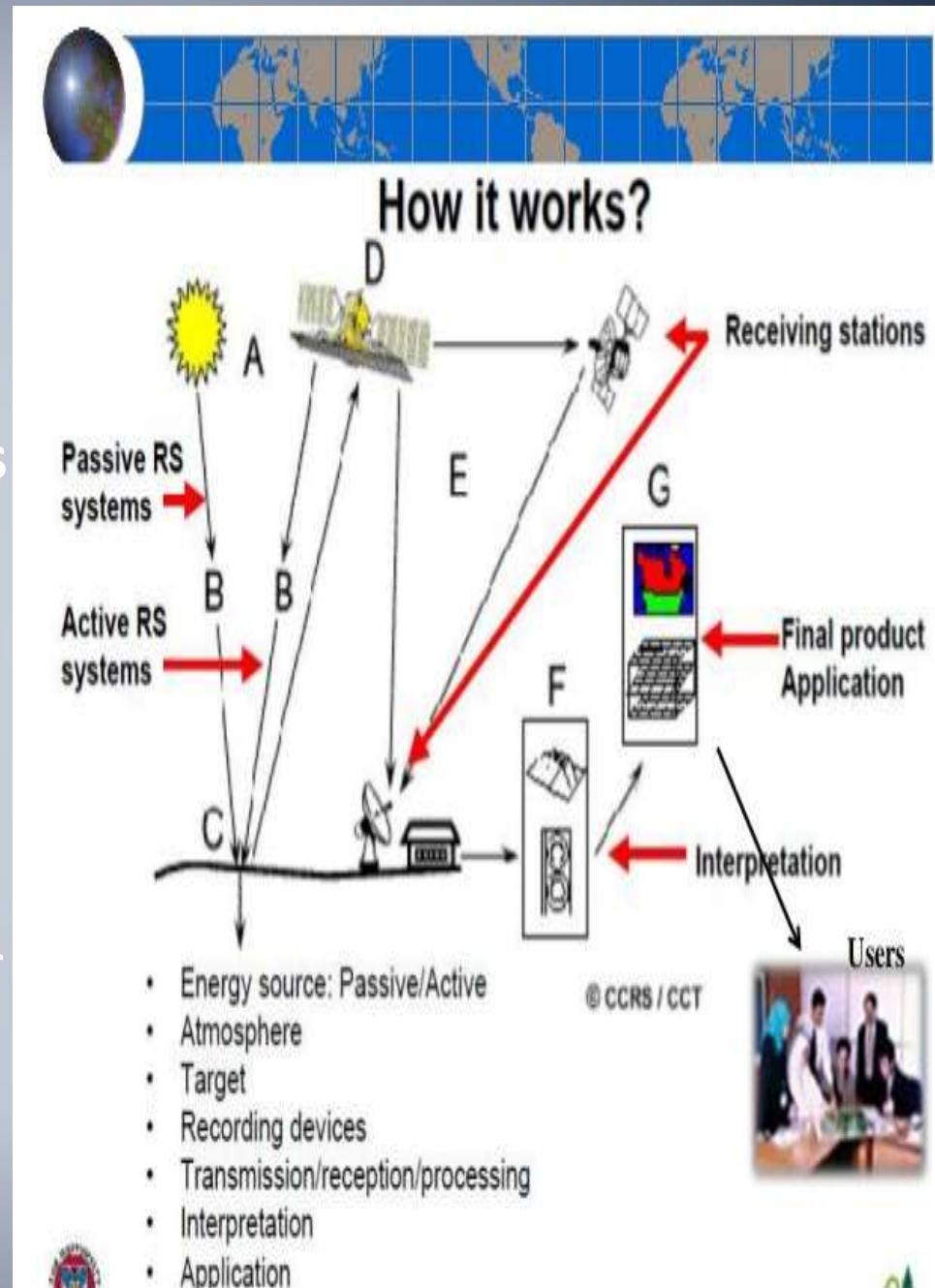


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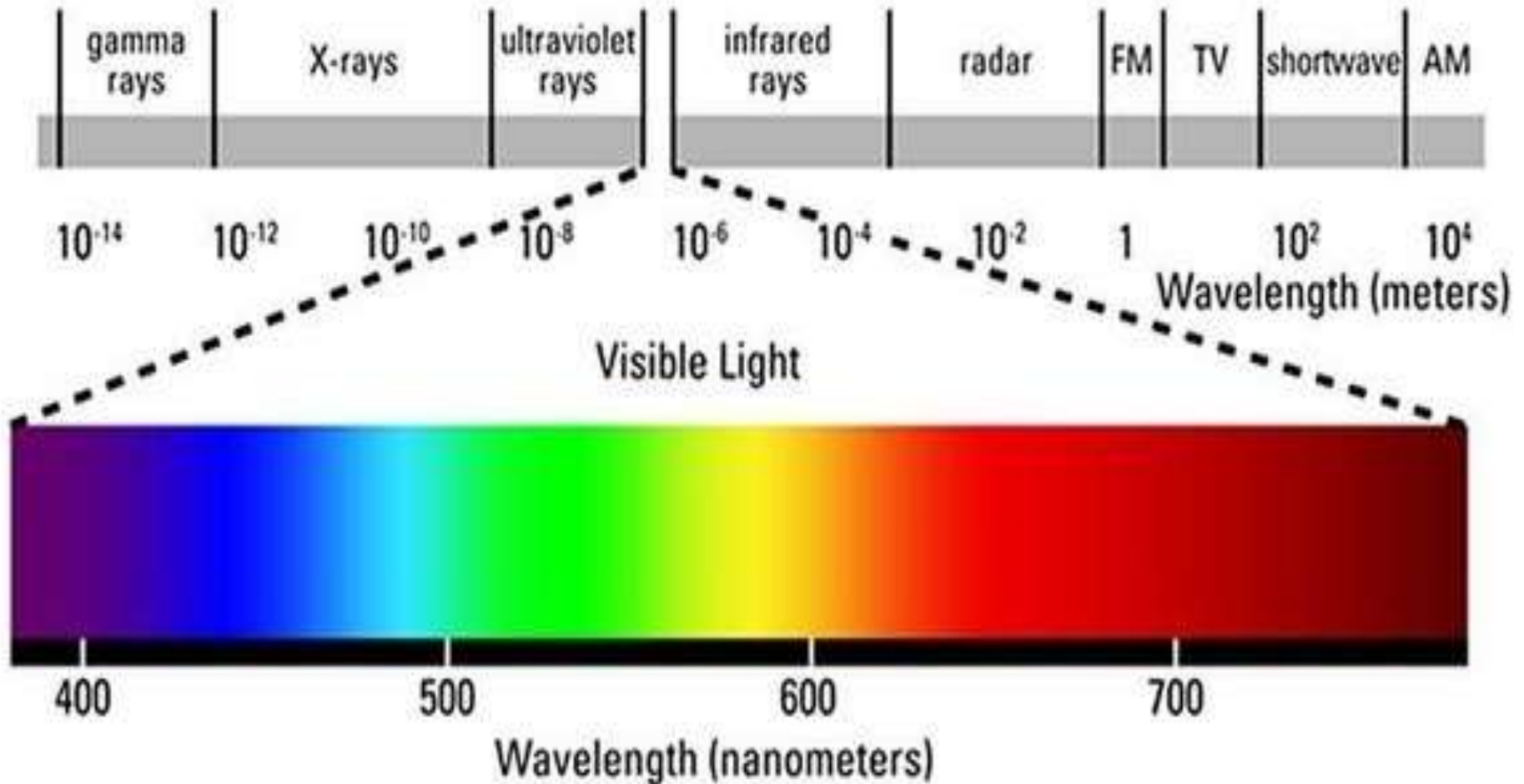


- 7. Application (G) - the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.



Electromagnetic spectrum :

The Electromagnetic Spectrum



Geographical information system(GIS)

- Indian Society of Geomatics (ISG) and Indian Space Application Centre (ISRO) defined GIS as a system which provides a computerised mechanism for integrating various geoinformation data sets and analysing them in order to generate information relevant to planning needs in a context.

- the word 'Geographic'

deals with spatial objects or features which can be referenced or related to a specific location on the earth surface. The object may be physical / natural or may be cultural / man made.

Geographic



+

Information



+

Systems



- the word 'Information'

deals with the large volume of data about a particular object on the earth surface. The data includes a set of qualitative and quantitative aspects which the real world objects acquire.

Geographic



+

Information



+

Systems



- 'System'

is used to represent systems approach where the complex environment (consists of a large number, of objects / features on the earth surface and their complex characteristics) is broken down into their component parts for easy understanding and handling, but is considered to form an integrated whole for managing and decision making.

Geographic



+

Information



+

Systems



Application of Remote Sensing in CZM

They are..

- **Study of coastal habitat**
- **Shoreline protection**
- **Marine water quality**
- **Marine environment and climate change**
- **Coastal zone management**

Study of coastal habitat

1. Coral reefs

- Knowledge about the extent and condition of coral reefs is useful **in planning conservation and preventive measures** to protect this fragile ecosystem.
- Coral reefs features such as type(fringing, atoll, platform, patch coral heads, etc..), reef flats reef vegetation, degraded reef, lagoons, live coral and coralline shelf can be mapped by using a various satellites(IRS LISS II and III)
- These **maps can be used as a basic input for identifying the boundaries of protected areas** and biosphere reserve.

- Coral reef **features have been mapped** using IRS LISS II and III data on 1:50,000 scale for the Indian reefs.
- It was observed that **coral reef degradation is more serious problem than total destruction**
- Coral reefs show distinct morphological and ecological characters. Water column modifies the apparent reflectance spectrum of an object on the sea bottom. Water column correction and contextual editing increased the classification accuracy. IRS-1C LISS III and PAN merged data have been used for coral reef zonation study .

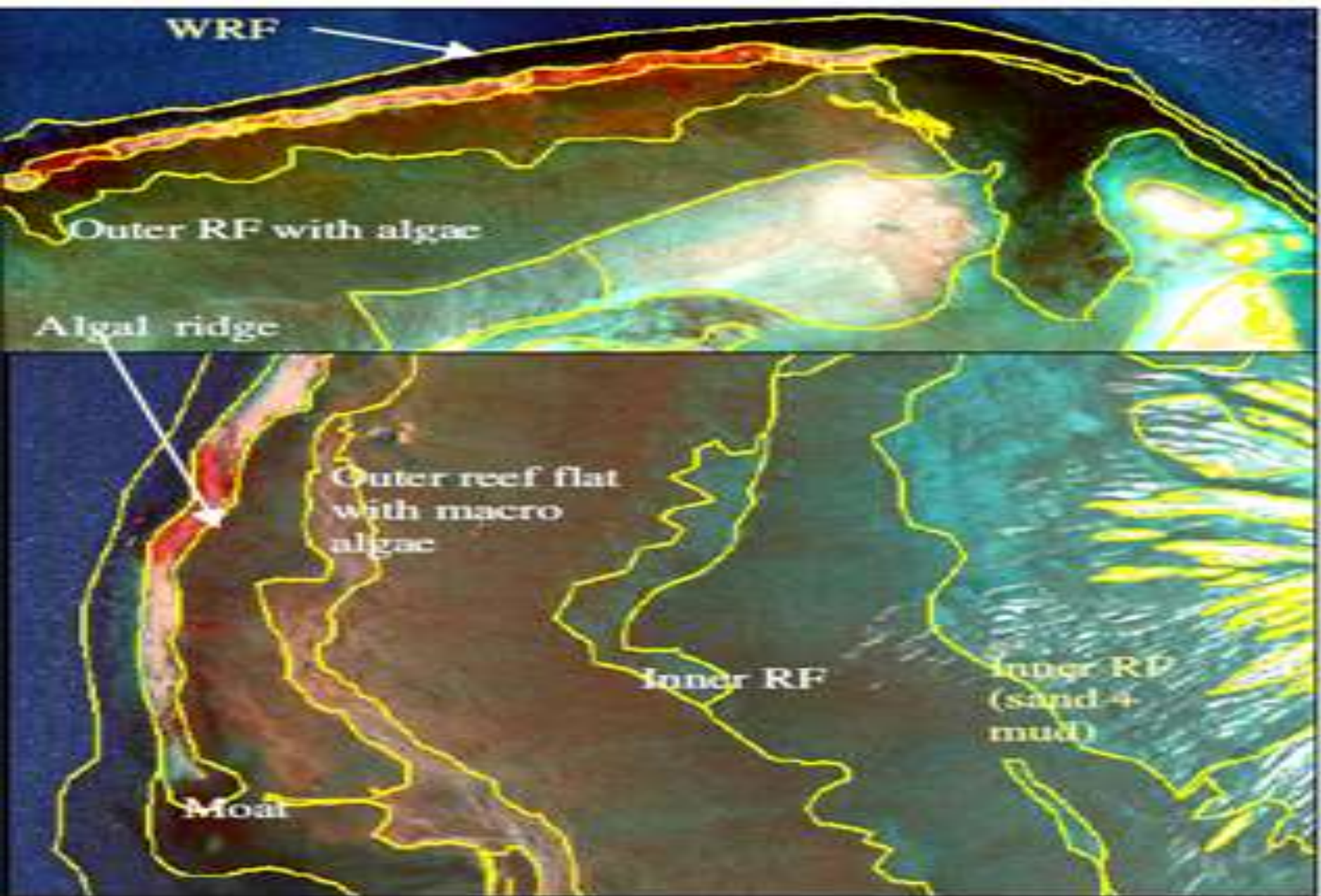


Fig. 3. Coral reef zonation (Gulf of Kachchh, Western India), using IKONOS data.

2. Mangroves:

- Mangroves help in the production of detritus, organic matter, **recycling of nutrients** and thus enrich the coastal waters and support benthos population of sea.
- Mangroves cover about 200,000 sq km areas on the globe, mainly around tropics.
- The Forest Survey of India has been providing estimates of mangroves based on satellite data since 1987. However, in some regions, mangroves have increased due to plantation as well as regeneration.
- In India, mangroves have reduced from 6740 to 4460 sq. km. Mangroves are degraded and destroyed due to conversion of these areas for agriculture, aquaculture on the East Coast and industrial purposes on the West coast



- Mangroves are characterised by the presence of particular dominant communities/species, physico-chemical environment, extent and frequency of inundation by tidal waves, salinity and a soil types.
- It is possible to identify major mangrove communities such as *Avicennia spp.*; *Rhizophora forest*, *Sonneratia spp.*, *Phoenix spp.* and mangrove scrub using *LISS III* and *PAN data* on the Indian sub-continent.
- The variation in pigment content, leaf structure and water content in mangroves leaves along with the associated features and location were exploited to identify dominant mangrove types.
- Information regarding different mangrove community zonation is a vital for biodiversity assessment and for preparing management plans for conservation.



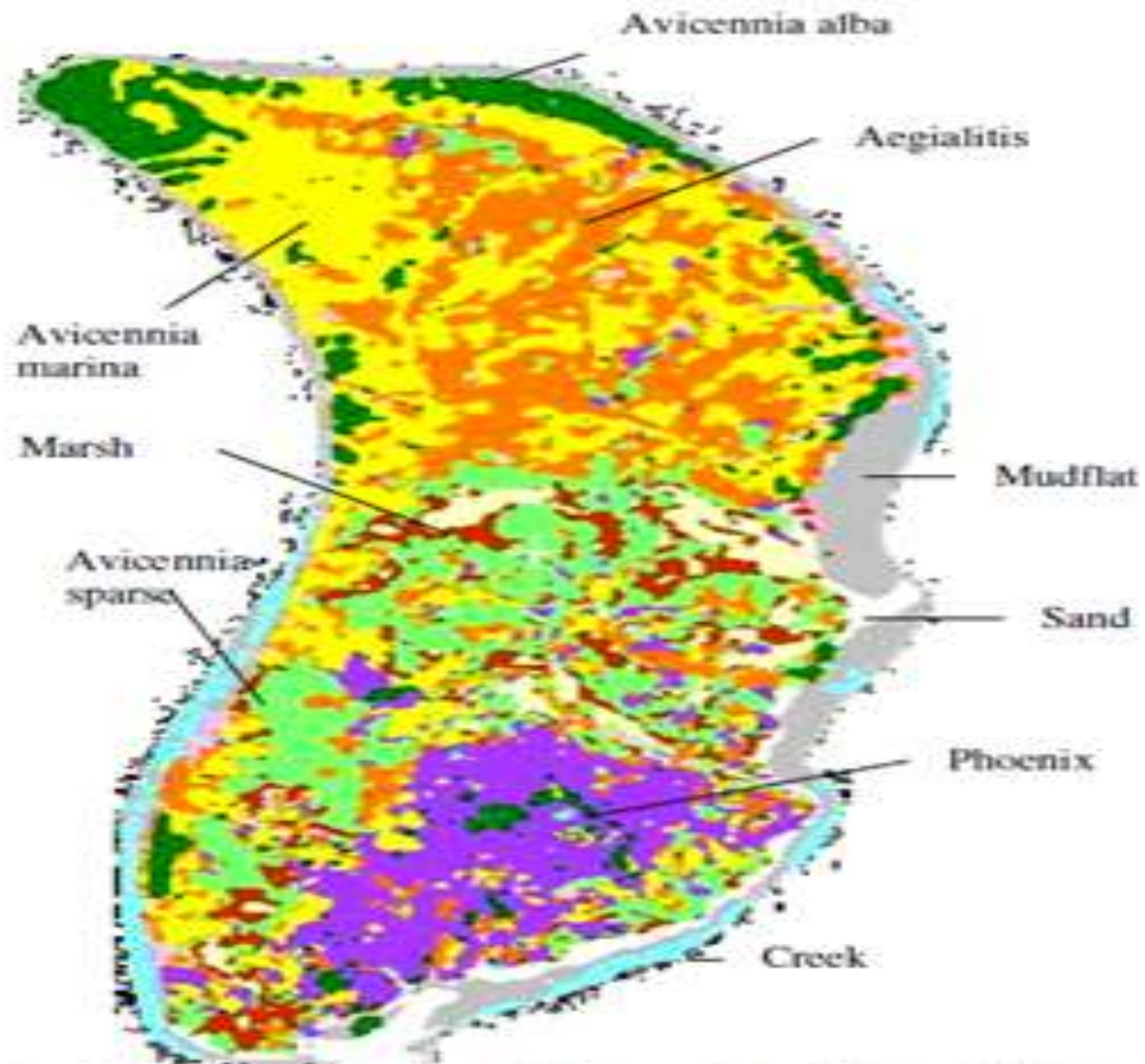


Fig. 2. Mangrove zonation in the part of Sunderbans, India using IRS LISS III and PAN merged data

Example of Sundarbans Mangroves..

3. Protected Areas:

- Many ecologically fragile areas are designated as 'Protected Areas' to preserve and conserve such ecosystems.
- However, it is not known, how much area will be sufficient for conserving biodiversity in vital/critical habitats, such as mangroves, coral reefs and wetlands.

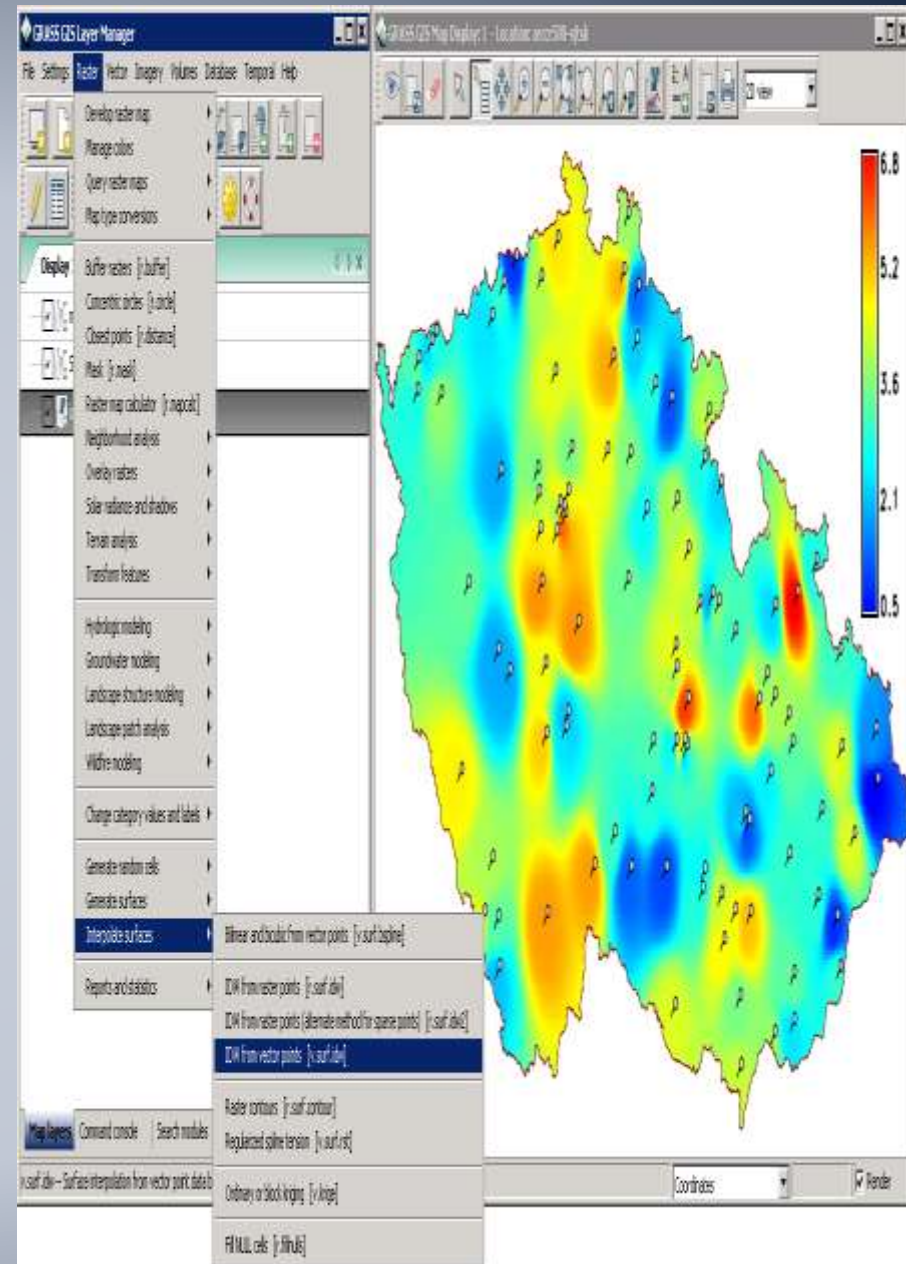


- It is necessary to monitor these areas to assess impact of conservation measures as well as anthropogenic activities. The repetitive coverage of the IRS satellites is quite adequate for monitoring such changes.
- In one such study, in the Marine National Park, Jamnagar, on the Gujarat coast significant changes in the mangrove vegetation and coral reef area were observed during the period 1975 to 2000.
- Degradation and loss of both ecosystems continued till 1985 on account of mining of coralline sand and use of mangroves as fuel and fodder.
- The loss of coastal habitats is a direct measure of declining condition of biodiversity in coastal habitats. Hence, In 1983, this area was declared as a marine park (protected area).
- Extensive measures were initiated for conservation of mangrove and coral reef areas by the marine park authorities.
- This resulted in reversing the trend of degradation after 1985 and has certainly helped towards restoring the environment

- However, recent industrialisation, development of ports, etc. have again put these ecosystems under stress, as evident from recent satellite data.
- Remote sensing data has been proved to be extremely useful for routine monitoring of the protected areas.

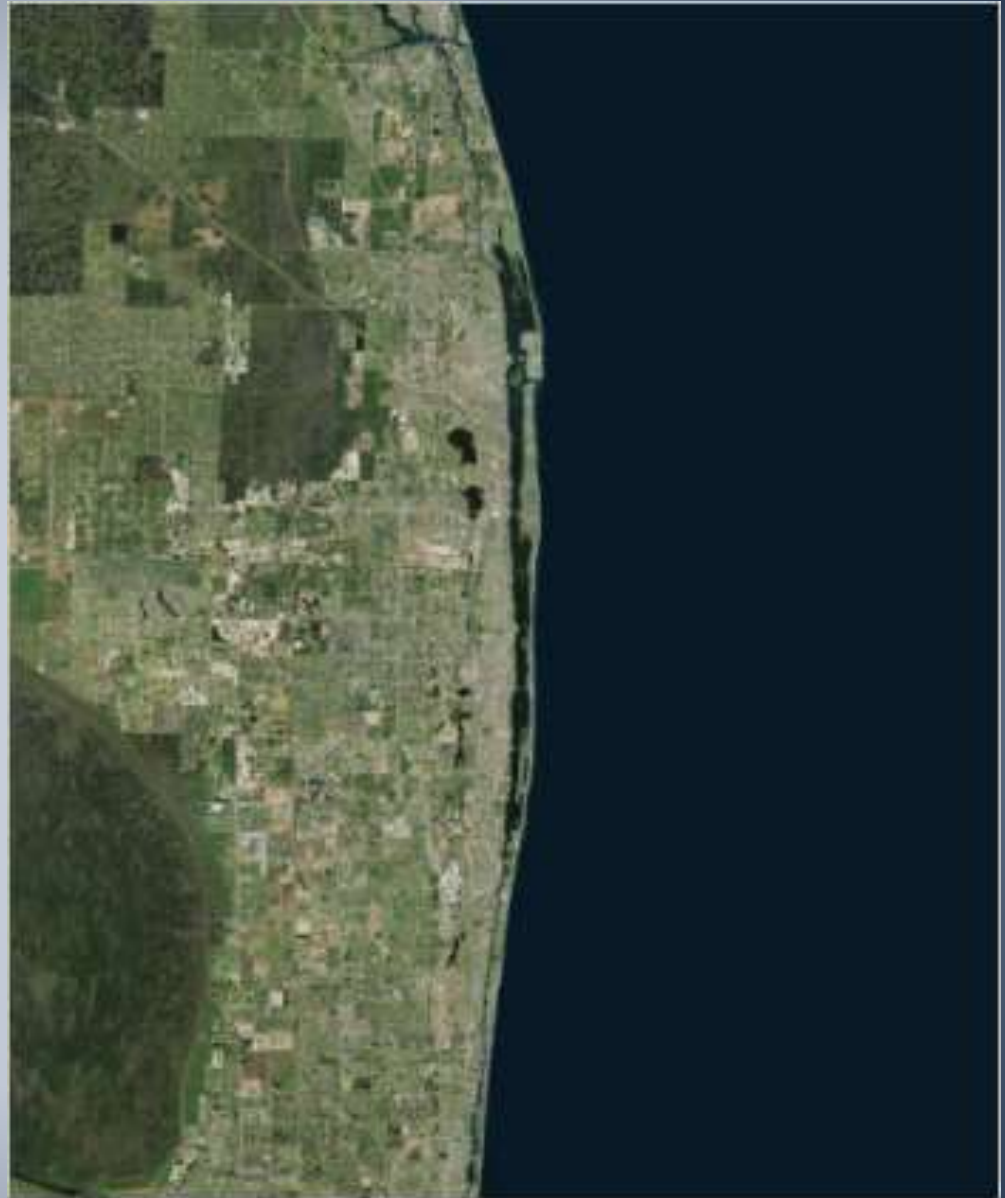
4. Marine fishery :

- The assessment of stock is one of the important activities for conserving the marine living resources. India has high potential for marine fisheries development.
- Identification of the marine living resources (PFZ)
- Detection of primary productivity for the prediction of tertiary productivity.
- Also help to understand the carbon uptake of oceans from the atmosphere
- Various satellites like IRS P4 (OCM), NOAA AVHRR, SST provides the PFZ areas.
- Forecast is 70-80% correct.



- **5. Shoreline protection**

- One of the major requirements of planning coastal protection work is to understand coastal processes of erosion, deposition, and sediment-transport, flooding and sea level changes, which continuously modify the shoreline.
- The historical and functional approaches to study shoreline changes along with various landforms help in deciphering the coastal processes operating in an area.
- Satellites involved in Indian shoreline mapping are like LANDSAT MSS/TM and LISS II on scale of 1:250,000 and 1:50,000.



- Erosion has been observed north of Visakhapatnam, Paradip, and Ennore, north of Madras, near Nagapattiam and Kanyakumari ports on the East Coast of India while deposition has been observed south of these ports.
- These changes are attributed to construction of artificial barriers like breakwater, jetties, etc.

6. Marine water Quality:

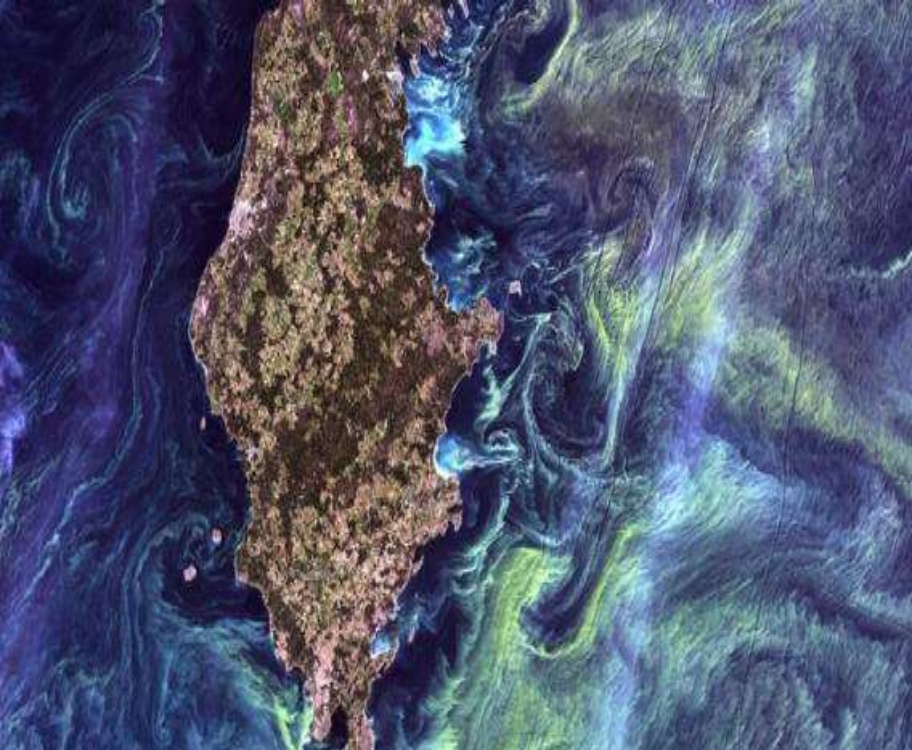
- Anthropogenic activities – i.e discharge of industrial and municipal sewage, land use, tourism, maritime transport, offshore oil exploration and production, dumping at sea degrade the marine environment.
- Turbidity, temperature and colour are indicators of water quality.
- Chlorophyll indicates trophic status, nutrient load and possibility of pollutants in coastal waters.



Fig. 7. A plume from a sugar factory and its dispersion (dark colour) in the Kakinada Bay, Eastern India.

harmful algal blooms

- Planktons produce certain toxins, which adversely affect fish and other organisms.
- The bloom usually takes place rather suddenly and may spread with amazing speed, changing colour of surface water into red, green or hay colour
- chlorophyll map was used to study such bloom in the Baltic Sea.
- IRS P4 OCM data have been used to monitor Trichodesmium bloom in the Arabian Sea using OCM data.



Aqua site selection

- . Aquaculture development and planning require comprehensive data on land use and water resources.
- IRS LISS II data was utilised to prepare coastal land use maps on 1:50,000 scale along the Indian coast.
- These maps show wetland features between high and low water lines and land
- use features of the adjoining shore (up to 1.5 km from high waterline). The land use/wetland information has been used for evaluating quality of the surrounding coastal waters, as this information was not available in most of the cases.
- The spatial distribution of mud/tidal flat areas, which are most suitable from substrate condition point of view give idea about potential available for brackish water aquaculture.
- These maps have been used by the Central and State Fisheries departments for evaluating proposed sites as well as for selecting new sites and reassessing potential for brackish water aquaculture.

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Thank you...

