THE MFRDMD/SEAFDEC FIRST REGIONAL WORKSHOP ON
REMOTE SENSING OF PHYTOPLANKTON

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TECHNICAL REPORT

REMOTE SENSING TECHNOLOGY FOR PHYTOPLANKTON

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Remote Sensing Technology

Fundamental principles:

- The characteristics and interaction of the electromagnetic radiation (EMR) as its propagates from source to sensor.

Description:

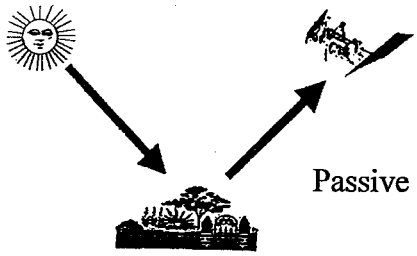
- The source of energy and the type and amount of energy it provides.
- The absorption and scattering effects of the atmosphere EMR.
- The mechanisms of EMR interaction with the earth surface features.
- The nature of sensor response as determined by the type of sensor.

Remote Sensing System

Passive sensor:

Use ambient radiation (what is around us to measure)

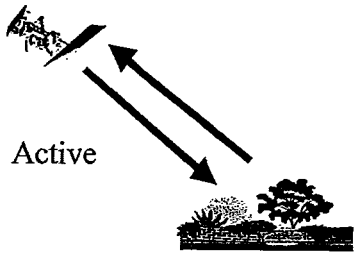
- Sunlight
- Heat from earth's surface
- Other microwave radiation



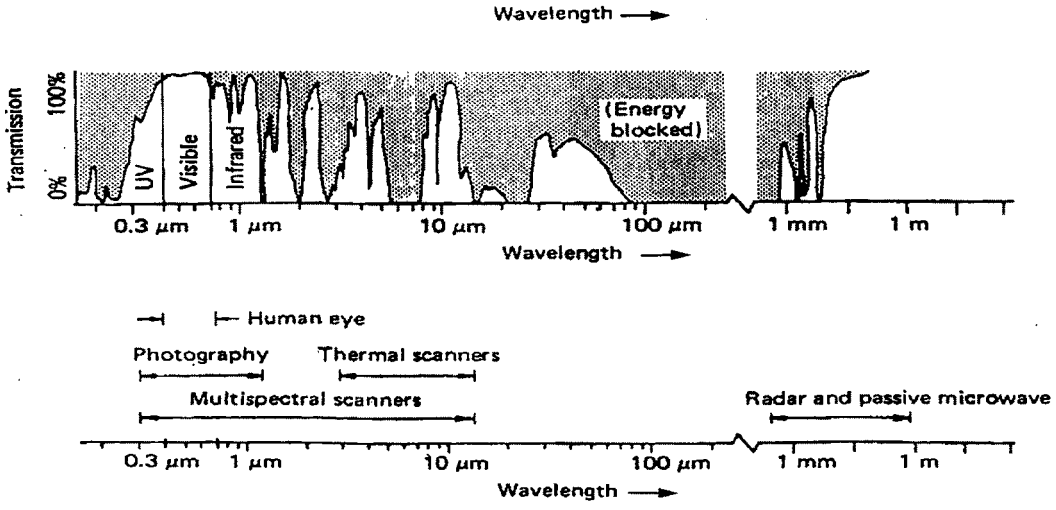
Active sensor

Illuminates a scene with some form of radiation

- Microwave – Radar, Altimeter, SAR
- Laser, altimeter, LIDAR



Electromagnetic Radiation (EMR)

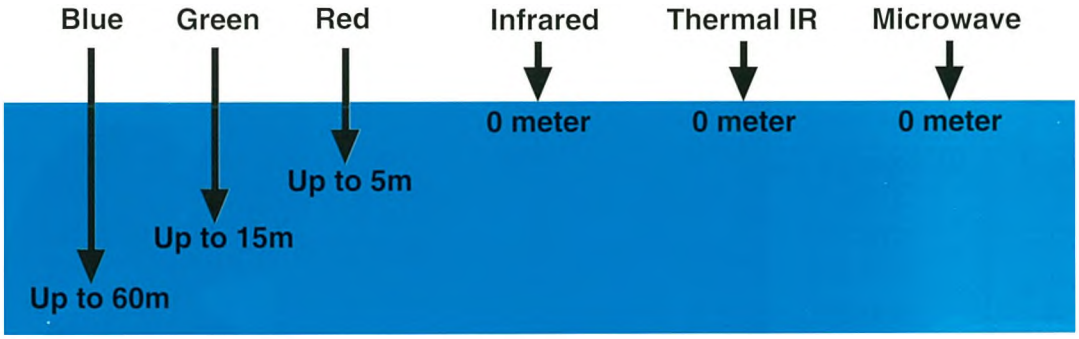


Remote Sensing Wavelength

Wavelength in remote sensing:

Passive:
- Visible
- Infrared
- Thermal infrared

Active:
- Microwave



Why Do We Use Satellite Remote Sensing?

- Repetition
  Repetition of data capture is consistent

- Coverage
  Coverage of large area in shortest time is suitable for dynamic phenomena

- Cost effective
  Cost per km^2 is low

Ideal remote sensing system

- Real-time imagery
- High spatial resolution
- High radiometric resolution

Current limitation

- Number of detector in sensor (now ~6000 detector)
- Satellite orbit and height

Remote Sensing for Phytoplankton Detection

Parameter that can be used for phytoplankton detection either direct or indirect:

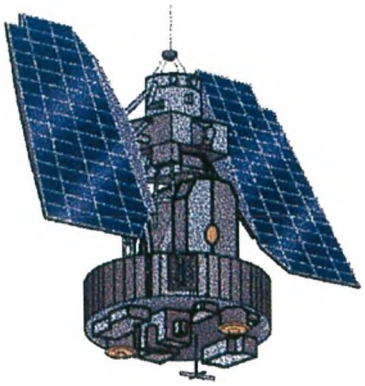
- Chlorophyll
- Ocean color
- CO_2
- Nutrient
- Sunlight in water

Remote Sensing Satellites

Archive data available

Nimbus-7

Sensor: Coastal Zone Colour Scanner (CZCS)



Band	Wavelength (nm)	Colour
1	455-453	Visible blue
2	510-530	Visible green
3	540-560	Visible yellow
4	660-680	Visible orange/red
5	700-800	Very near infrared

Currently available

SEASTAR

Sensor: SeaWiFS
(= Coastal Zone Colour Scanner)

Band	Wavelength (nm)	Bandwidth (nm)	Colour	Measurement
1	412	20	Violet	Dissolved organic matter (violet
2	443	20	Blue	absorption)
3	490	20	Blue/Green	Chlorophyll (blue absorption)
4	510	20	Green	Chlorophyll (blue/green absorption)
5	555	20	Green/Yellow	Chlorophyll (green absorption)
6	670	20	Red	Chlorophyll (green reflection)
7	765	40	Near Infrared	Atmospheric aerosols
8	865	40	Near Infrared	Atmospheric aerosols
				Atmospheric aerosols

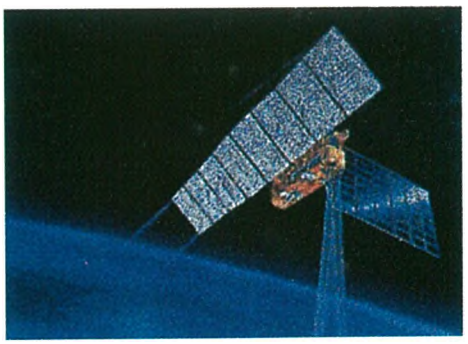
ADEOS

Sensors:

- Ocean Color and Temperature Scanner (OCTS) by NASDA Japan
- Advanced Visible and Near Infrared Radiometer (AVNIR) by NASDA Japan
- NASA Scatterometer (NSCAT) by NASA America
- Total Ozone Mapping Spectrometer (TOMS) by NASA America
- Interferometric Monitor for Greenhouse Gases (IMG) by IMG Japan
- Polarization and Directionality of the Earth's Refrectance (POLDER) by CNES France
- Improved Limb Atmospheric Sounder (ILAS) by MITI Japan
- Retroreflector In Space (RIS) by IMG Japan

JERS

Sensor : Optical Scanner (OPS)



Main specifications of OPS

- Swath width: 75 km
- Resolution: 18m x 24m
- Bands: Visible & near infrared (3)
  Shortwave infrared (4)
  Stereoscopic (1)
- High in noise, unsuitable for use

NOAA

Sensor: Advance Very High Resolution Radiometer (AVHRR)

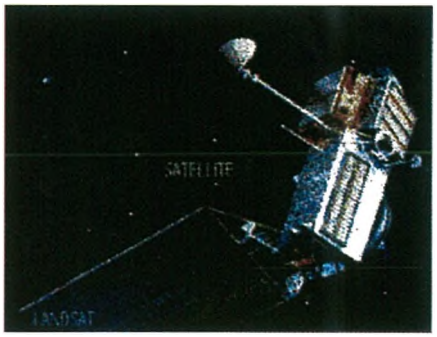
AVHRR characteristics:

Band	Wavelength (μm)	Primary use
1	0.58-0.68	Daytime cloud/surface mapping
2	0.725-1.10	Surface water delineation, ice and snow melt
3A	1.58-1.64	Snow / ice discrimination (NOAA K,L,M)
3	3.55-3.93	Sea surface temperature, nighttime cloud mapping
4	10.3-11.3	Sea surface temperature, day and night cloud mapping
5	11.5-12.5	Sea surface temperature, day and night cloud mapping

LANDSAT 4 & 5

Sensor : Thematic Mapper

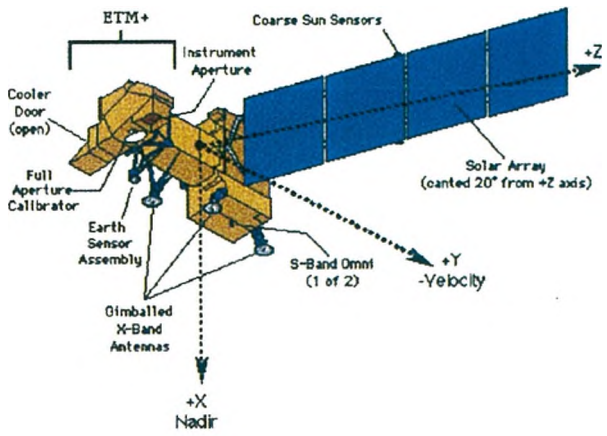
Band	Wavelength (μm)	Spectrum
1	0.45-0.52	Blue-green
2	0.52-0.60	Green
3	0.63-0.69	Red
4	0.76-0.90	Near Infrared
5	1.55-1.75	Infrared
6	10.4-12.5	Thermal Infrared
7	2.08-2.35	Far Infrared



Future Satellite

LANDSAT 7

Band	Wavelength (nm)
1	450-515
2	525-605
3	630-690
4	750-900
5	1550-1750
6	10400-12500
7	2090-2350
Panch.	520-900



ADEOS II

Sensor same as ADEOS I, with 5 additional sensors:

- Advanced Microwave Scanning Radiometer (AMSR)
- Global Imager (GLI)
- Sea Winds (SeaWinds)
- Polarisation and Directionality of the Eatrh's Reflectances (POLDER)
- Improved Lomb Atmospheric Scatterometer-II (ILAS-II)

Research at Remote Sensing Centre, UTM

Oceanography:

- Bathymetry
- Seagrass
- Coral reefs
- Suspended Sediment Concentration
- Sea Surface Temperature
- Sea Bottom Features
- Wave height and direction
- Wind speed and direction