Lecture-5

EMR Inter action with Atmosphere

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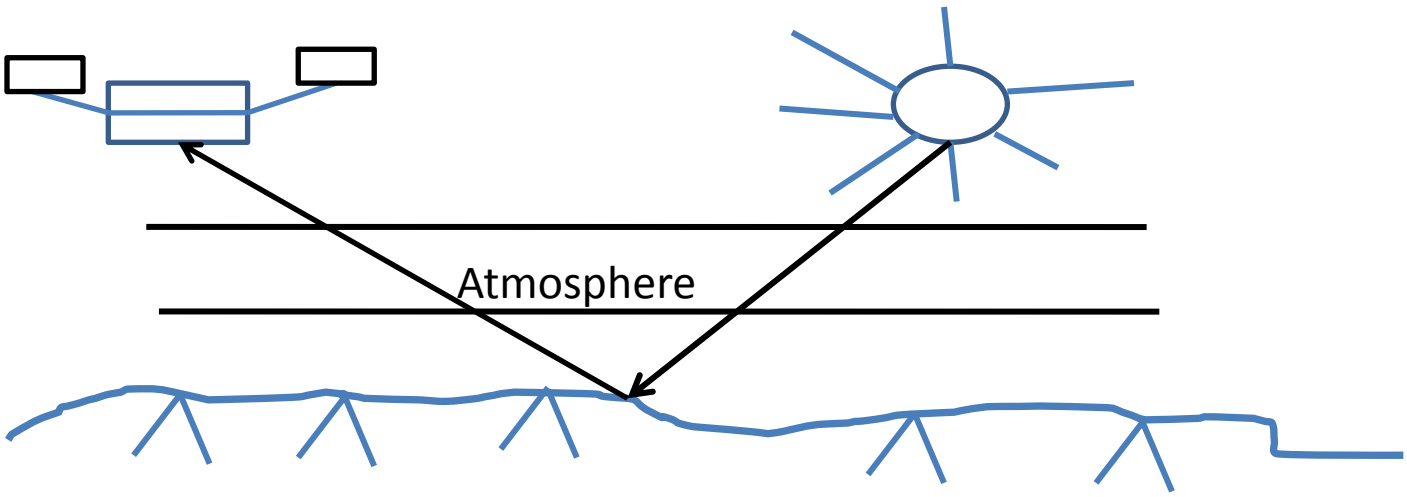
EMR Inter action with Atmosphere



EMR interacts with atmosphere both during onward and retreat transit

Atmosphere contains

- Gases
- Suspended materials
- Water molecules

These atmospheric impurities causes

- Atmospheric scattering
- Atmospheric absorption

These two depends upon

- Path length
- Transmissivity of atmosphere

a. Path Length

- Distance traveled by EMR in atmosphere
- EMR has travelled twice
- But earth emitted energy has travelled only once
- Path length is a function of
  - ✓ Location of energy sources
  - ✓ Altitude of plat form

b. Transmissivity of the atmosphere

- Is the efficiency of the atmosphere to transmit light
  - ➢ It depends upon wave length
  - ➢ 'T' is a measure fraction of radiance emenated from ground

Atmospheric absorption

1.When EMR passes through atmosphere it is selectively absorbed by

- GASES
- Water molecules
- Other dust particles

(H_2O, CO_2, O_3)

Due to

- Rotational
- Vibratioal
- Electronic energy levels

2.When EMR falls on such particles the photons available in them are energised and as a result they absorb light

- This is called **<u>"atmospheric absorption"</u>**

3.Atmosperic Windows

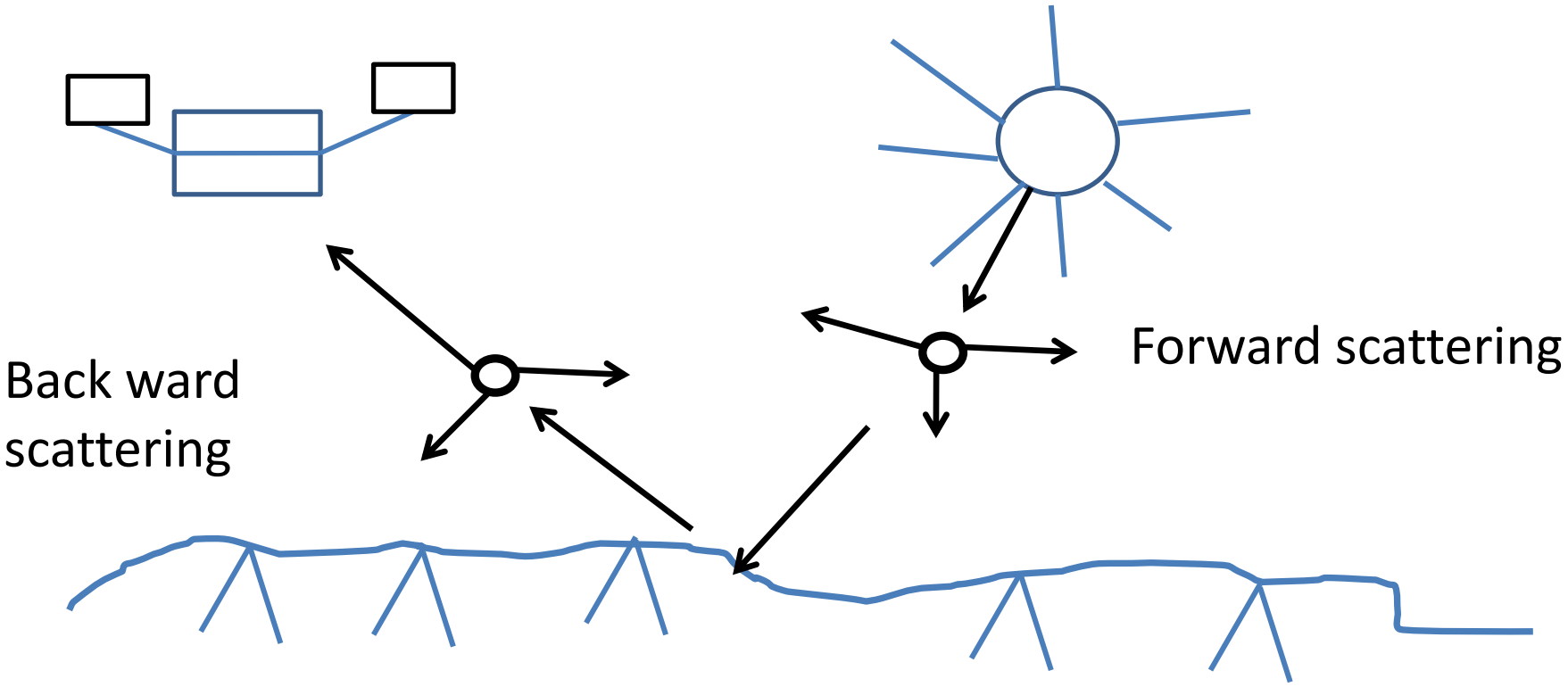
- In between UV and microwave region only certain selected wave length are observed
- Such spectral zone of least is called atmospheric windows

Atmospheric Windows

Name	wave length
1.UV/Visible	0.3-.75 micrometer
2.Near IR	0.77-0.90
3.SWIR	1.0-1.12 1.19-1.34 1.55-1.75 2.05-2.4
4.Middle IR	3.5-4.16 4.5-5.0 8-9.2 10.2-12.4 8-14 17-22

Atmospheric scattering

i. Diffuse multiple reflection of EMR by atmosphere



ii.Types of Scattering

a. Rayleigh(Molecular)

When the light hits tiny particles whose diameter is less the wave length of light Raleigh scattering take place

$$R \alpha 1/\lambda^4$$

- More sever in UV and blue region
- This is the reason for blue colour in sky
- Cause blue haze in imagery

b. Mie Scattering(Non molecular)

- When atmospheric particles are spherical and larger than the wave length of EMR then Mie scattering
  - Due to the dust and vapour
  - Scatters UV to IR
  - This is causes reddishness in Sky

C.Non selective scattering

- Due to largest particle size (5 to 100 micrometer) all light from UV to MIR will be uniformly scattered
- Cloud white
- Rain bow

III. Atmospheric luminance

- It is defined as luminant flux incident on an unit area
- This is also affects the EMR
- As the final light reaching the ground is the sum of
  - Direct sunlight +
  - Moon light+
  - Atmospheric luminance caused by scattered light

- But the atmospheric luminance caused by scattered light

EMR interaction with earth surface Features

When sun light falls on it is

- Absorbed
- Diffracted
- Scattered
- Polarised
- Reflected

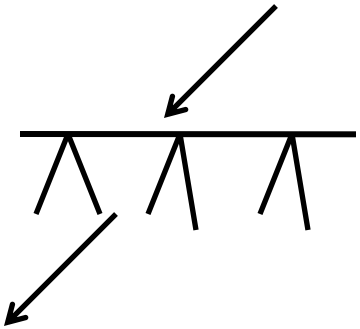
Depending upon

- Size
- Shape
- Surface roughness
- Other physical properties of the earth surface

Absorbtion

Absorption + Diffraction + Transmission

- If the medium homogeneous –simple transmission



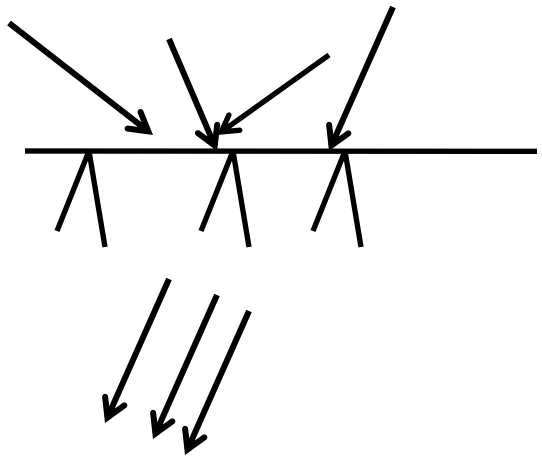
Heterogeneous object- Internal scattering

- Absorption and transmission depends upon the dielectric constant
- The dielectric constant is the ratio of the permittivity of a substance to the permittivity of free space. It is an expression of the extent to which a material concentrates electric flux, and is the electrical equivalent of relative magnetic permeability.

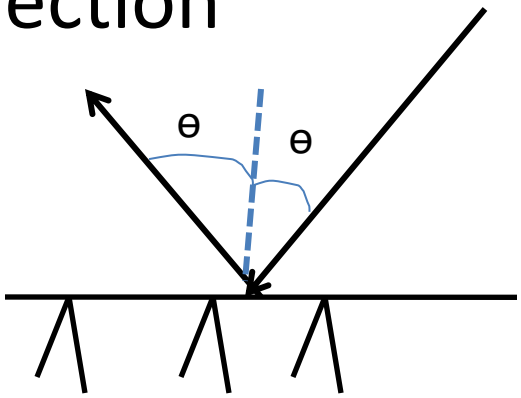
❖ Dielectric constant depends upon

- Wave length of the light
- Sp.gravity of the object
- Cation, anion, and solid solution
- Impurities, trace element
- Moisture content

- Polarisation

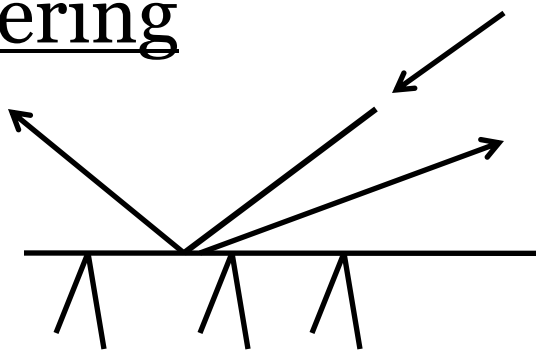


- Reflection

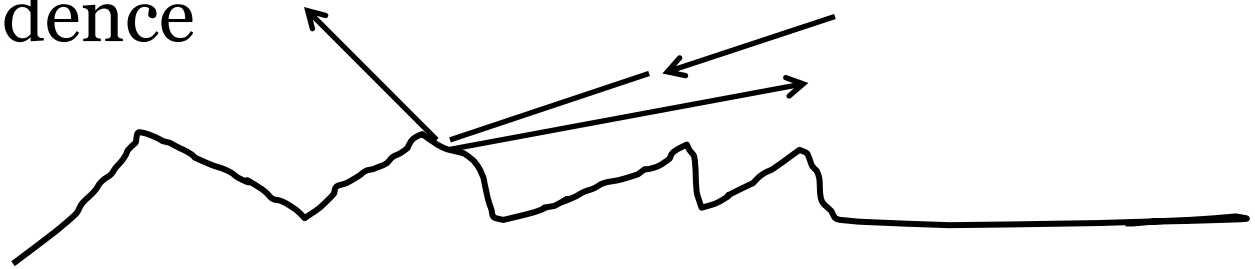


- Follows Snell's law
- Angle of incident= Angle of reflection

Scattering



- In rough surface light will be scattered
- In Lambertian surface light will be reflected equally in all direction irrespective of angle of incidence



- Surface roughness is an important function in scattering