UNIT-II

EMR Interactions with the Atmosphere

Before radiation reaches the earth's surface it has to travel through some distance of the earth's atmosphere. Particles, gases and water vapour present in the atmosphere can affect the incoming light and radiation. These effects are caused by the mechanisms of scattering and absorption.

1.Scattering

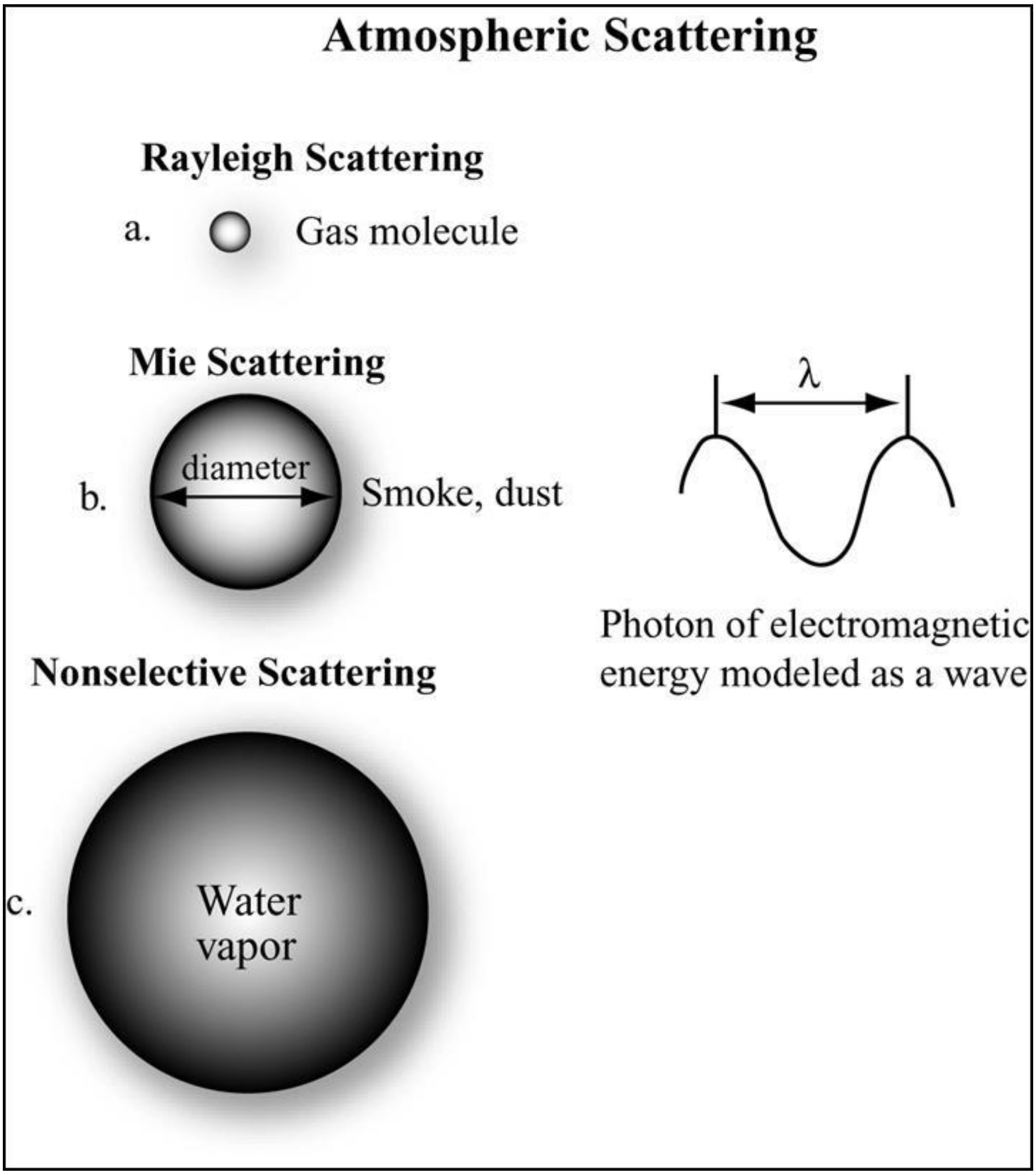
Scattering is defined as the unpredictable diffusion of radiation by the particles in the atmosphere. This diffusion or redirection of the electromagnetic energy is done by the particles suspended in the atmosphere or by large molecules of atmospheric gases. The scattering is classified in to selective and non-selective scattering.

Types of scattering

1.Rayleigh Scattering- It happens in the upper part of the atmosphere, also called as clear atmospheric scattering. This happens when radiation interacts with atmospheric molecules and other tiny dust particles, which are smaller in diameter than the wavelenth of the interacting radiation wavelength. The sky appears blue during the day is because of this phenomenon. As synlight passes through the atmosphere, the shorter wavelengths (blue) of the visible spectrum are scattered more than the other visible wavelengths.

2.Mie Scattering - It happens when the atmospheric particles diameter are of same size as that of wavelenth of radiations being sensed. Spherical particles of water vapur, pollen grains and dust cause Mie's scattering, mainly in the lower parts of the atmosphere.

3. Non Selective Scattering – Non selective scattering is independent of wavelength. It is produced by particles whose radii exceed 10 micro meter, such as water droplets and large dust particles can cause this type of scattering. Nonselective scattering gets its name from the fact that all wavelenths are scattered about equally. This type of scattering causes fog and clouds to appear white to appear white to our eyes because blue, green and red light are all scattered in appreoximately equal quantities (blue+green+red light = white light).



2.Absorption

Absorption is the other main mechanism at work when electromagnetic radiation interacts with the atmosphere. Absorption is a thermodynamically transformation of radiant energy into heat energy. Ozone, carbon dioxide, and water vapour are the three main atmospheric constituents which absorb radiation.

Ozone serves to absorb the harmful ultraviolet radiation from the sun. Carbon dioxide refered to as a greenhuse gas because it tends to absorb radiation strongly in the far infrared portion of the spectrum- that area associated with thermal heating-which serves to trap this heat inside the atmosphere. Water vapour in the atmosphere absorbs much of the incoming longwave infrared and shortwave microwave radiation.

EMR Interactions with earth's surface

When electromagnetic energy reaches the earth's surface there are three possible energy interactions with the surface feature:

1. Reflection: occurs when radiation "bounces" off the target and is redirected

2. Absorption: occurs when radiation (energy) 9s absorbed into the target

3. Transmission: occurs whem radiation passes through a target

The principle of energy conservation, energy can neither be created nor destroyed, but it can be transferred.

Incident energy (from sun)= Reflected energy+Absorbed energy+Transmitted energy

The proportion of energy reflected, absorbed and transmitted will vary depending on the surface material, condition and wavelength of the energy. For example vegetation and soils can reflect approximately 30-50% of the incident energy (across the entire EM spectrum) while water on the other hand reflects only 10% of incident energy. Water reflects most of this in the NIR and beyond 1.2 micro meter (mid-infrared) water absorbs nearly all energy.

PLATFORMS

Platforms refer to the structures or vehicles on which remote sensing instruments are mounted.

REMOTE SENSING PLATFORMS

Types of platforms :

- **Ground based platforms**
  - Short range systems(50-100 m)
  - Medium Range Systems (150-250 m)
  - Long range Systems (up to 1 km)
- **Airborne platforms**
- **Space-borne platforms**

1 Ground based - Some of the more common ones are hand held devices, tripods, towers and cranes. Instruments that are ground-based are often used to measure the quantity and quality of light coming from the sun or for close range characterization of objects. For example, to study properties of a single plant or a small patch of grass, it would make sense to use a ground based instrument.

*Laboratory instruments are used almost exclusively for research, sensor calibration, and quality control.

*Field instruments are also largely used for research purposes. This type of remote sensing instrument is often hand-held or mounted on a tripod or other similar support. The term "skyshed" in Figure 5.04, Panel c, refers to indirect (also known as diffuse) illumination from the sky (as opposed to direct sunlight).

*Permanent ground platforms are typically used for monitoring atmospheric phenomenon although they are also used for long-term monitoring of terrestrial features. Towers and cranes are often used to support research projects where a reasonably stable, long-term platform is necessary. Towers can be built on site and can be tall enough to project through a forest canopy so that a range of measurements can be taken from the forest floor, through the canopy and from above the canopy.EG. The BOREAS (Boreal Ecosystem-Atmosphere Study) field experiment was conducted to gain knowledge about relationships between the boreal forest and Earth's atmosphere.

2. **Airborne platforms** : Low altitude aircraft typically fly below altitudes where supplemental oxygen or pressurization are needed (12,500 feet above sea level). They are good for acquiring high spatial resolution data limited to a relatively small area. Included in

this class are the common fixed-wing, propeller driven planes used by private pilots, such as the Cessna 172 or 182, and Piper Cherokee.
*Helicopters are usually used for low altitude applications where the ability to hover is required. Helicopters are quite expensive to operate and they are typically used only when needed. Ultralight aircraft are a class of aircraft that is gaining popularity. The Federal Aviation Authority (FAA) defines an ultralight as a single seat powered flying machine that weighs less than 254 pounds, has a top speed of 55 knots (63 mph), stalls at 24 knots (28 mph)
*Midaltitude aircraft have an altitude limit under 30,000 feet above sea level. This includes a number of turbo-prop aircraft. Often at higher altitudes, there is less turbulence so stability is better. This class of airplane is used when stability is more important and when it is necessary or desired to acquire imagery from a greater distance than available from low altitude aircraft. These aircraft can obtain greater areal coverage more quickly than low altitude platforms. An example of this class is the C-130 cargo plane and the Cessna C402.
*High altitude aircraft can fly at altitudes greater than 30,000 feet above sea level. This class of airplane is usually powered by jet engines and is used for specialized tasks, such as atmospheric studies, research to simulate satellite platforms, and other applications where a high altitude platform is required. High altitude aircraft are good for acquiring large areal coverage with typically lower spatial resolutions.
*Another class of aircraft that has been in use for many years is remote control aircraft, or drones. Remotely controlled aircraft are often used for conditions when it may be too hazardous to fly. They have been used extensively by the military.
3. Space- borne platforms - The most stable platform aloft is a satellite, which is **spaceborne**. The first remote sensing satellite was launched in 1960 for meteorology purposes. Now, over a hundred remote sensing satellites have been launched and more are being launched every year. The Space Shuttle is a unique spacecraft that functions as a remote sensing satellite and can be reused for a number of missions. The Space Shuttle has a low orbital altitude of 300 km whereas other common remote sensing satellites typically maintain higher orbits ranging from 600 to 1000 km. The payload for remote sensing satellites can include photographic systems, electro-optical sensors, microwave or Ridar systems. For applications benefiting from simultaneous coverage by different sensors, more than one sensing system can be mounted on a single satellite. In addition to sensor systems, there are often devices for recording, preprocessing and transmitting the data.

REMOTE SENSING PLATFORMS

Types of platforms :

Ground Based Platforms:

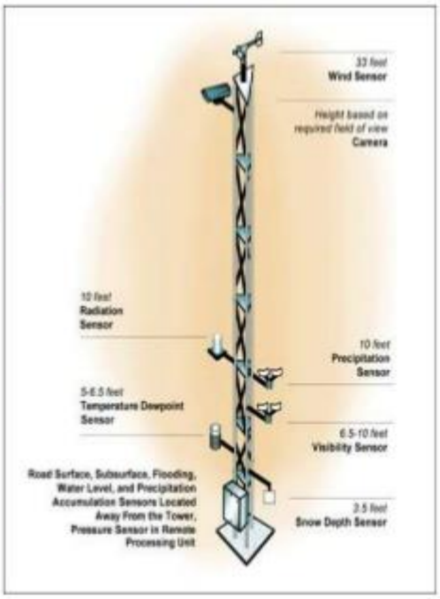
Mobile hydraulic platforms (up to 15 m height)

REMOTE SENSING PLATFORMS

Types of platforms :

Towers:

- **Greater rigidity than masts**



REMOTE SENSING PLATFORMS

Types of platforms :

Portable Masts

- **Unstable in wind conditions**

REMOTE SENSING PLATFORMS

Types of platforms :

Airborne Platforms:

Balloons based :

- **Altitude range is 22-40 km**
- **Tool to probing the atmosphere**
- **Useful to test the instruments under development**

REMOTE SENSING PLATFORMS

Types of platforms :

Airborne Platforms:

Radiosonde:

Measure pressure, Temperature and Relative humidity in the atmosphere

Rawinsonde:

Measure wind velocity, temperature, pressure and relative humidity