Introduction to Atmospheric Science
Insolation and the Earth’s Surface

I. **Insolation** – Incoming Solar Radiation, or the amount of solar radiation received at the Earth’s surface.

A. The sun emits all wavelengths of the electromagnetic spectrum, called solar radiation.

B. Approximately 50% of the solar radiation received at the Earth’s surface is in the visible light portion of the E.M spectrum.
II. Factors Affecting Insolation – there are six main factors that affect the intensity of radiation received at the Earth’s surface.

A. Angle of Insolation

1. The intensity of insolation increases, as the angle of insolation gets closer to 90 degrees.

2. The intensity of insolation decreases with an increase in latitude.

3. The angle of insolation varies throughout the day.
Relationship of Intensity and Angle of Insolation
B. **Duration of Insolation** – the length of time that Earth’s surface receives insolation.

1. The surface temperature at a particular location on the Earth is directly related to the duration of insolation.
2. The duration of insolation varies with latitude and the season of the year. Maximum insolation occurs in the Northern Hemisphere around June 21st (Summer Solstice).
3. Maximum Surface temperature occur at the Earth’s surface after the maximum duration of insolation.
4. Average annual surface temperature on the Earth are inversely related to latitude location.

C. Absorption of Insolation – Approximately 19% of incoming solar radiation is absorbed by the atmosphere.
1. Approximately 47% of insolation is absorbed by the Earth’s surface.

D. Reflection of Insolation –
Approximately 34% of insolation received by the Earth is reflected back into space by clouds (25%), snow, ice caps, and water.
E. **Scattering of Insolation** – Insolation can be scattered by molecules of gas, water, or dust in the Earth’s Atmosphere. This is why the sky is blue.

F. **Energy Conversion** – Insolation can be transferred to stored potential energy (Latent Heat) by evaporation of water, or sublimation of ice.

III. **Terrestrial Radiation** – Once insolation is absorbed by the Earth’s surface, it eventually gets re-radiated back into the atmosphere or into space.

A. The Earth’s surface radiates energy mainly in the infrared range of the E.M spectrum.

B. Some of this infrared radiation is trapped by gases in the atmosphere. This helps to heat the atmosphere and the planet. This effect is called the greenhouse effect.
C. Gases in the atmosphere that trap this heat are called greenhouse gases and include water vapor, carbon dioxide, methane, and CFC's.

E. Humans and Climate Change – burning fossils fuels has increased the amount of carbon dioxide in the atmosphere.
Thousands of years ago,

Concentration

-12  -10  -8   -6   -4   -2   0   2   4

Temp (C)

CO2 ppmv  CH4 ppbv  delta temp (degrees C)
Atmospheric Carbon Dioxide
Measured at Mauna Loa, Hawaii
The Goldilocks Syndrome
Pedersen Glacier

2005

1920
Muir and Riggs Glaciers

2004

1941
Recent Sea Level Rise

23 Annual Tide Gauge Records

- Three Year Average
- Satellite Altimetry