Radiation from the Sun

IB PHYSICS | ENERGY PRODUCTION

Intensity

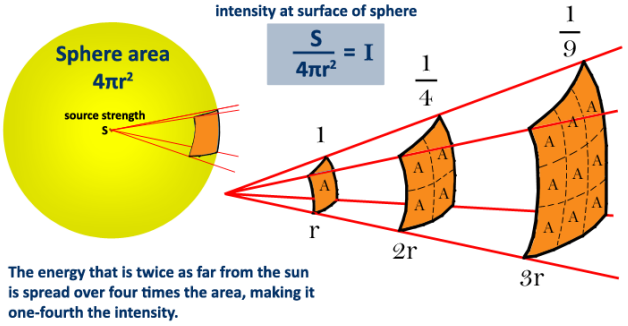
$$Intensity = \frac{Power}{A}$$

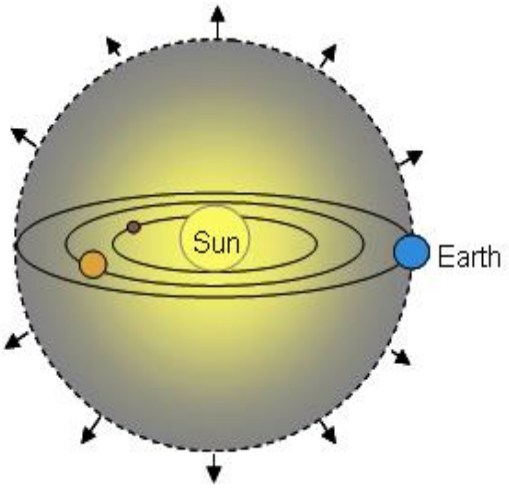
Intensity

Calculate the intensity of the Sun's radiation arriving to Earth

Sun's Power = 3.84×10^{26} W

Earth's Distance from Sun = 150×10^{6} km





Solar Constant

The average intensity falling on an area above the earth's atmosphere perpendicular to the direction traveled by the radiation

$$S = 1360 \text{ W m}^{-2} = 1.36 \times 10^{3} \text{ W m}^{-2}$$

Quantity	Symbol	Approximate value
Elementary charge	e	1.60×10^{-19} C
Electron rest mass	m_e	9.110×10^{-31} kg = 0.000549 u = 0.511 MeV c^{-2}
Proton rest mass	m_p	1.673×10^{-27} kg =1.007276 u = 938 MeV c^{-2}
Neutron rest mass	m_n	1.675×10^{-27} kg =1.008665 u = 940 MeV c^{-2}
Unified atomic mass unit	u	1.661×10^{-27} kg = 931.5 MeV c^{-2}
Solar constant	S	1.36×10^{3} W m^{-2}
Fermi radius	R_0	1.20×10^{-15} m

Average Solar Intensity on Earth

Earth's Radius = 6.37×10^6 m

Area of sun power captured:

Total sun power captured:

Average spread out across Earth's surface:

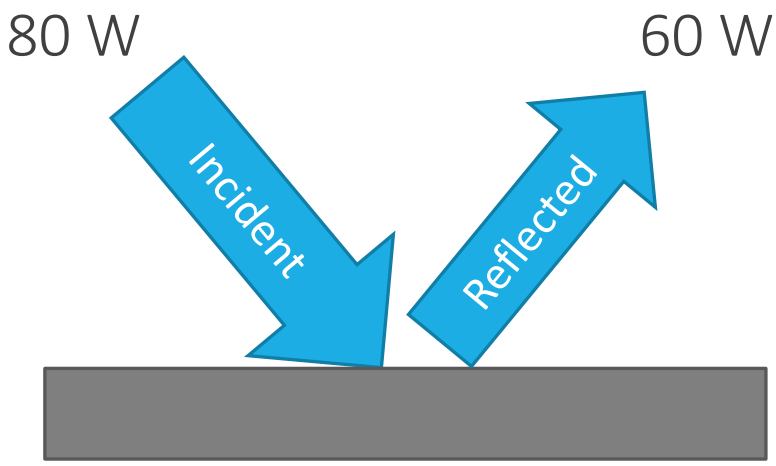
Total Power Received by the Earth
Average Solar Intensity on Earth

Albedo vs. Emissivity

Albedo
$\frac{power\ scattered\ by\ a\ body}{incident\ power}$

Emissivity	e
$\frac{power\ radiated\ by\ a\ surface}{power\ radiated\ from\ a\ black\ body}$	

Albedo vs. Emissivity



Albedo

Emissivity

Albedo of Earth

Albedo of Earth

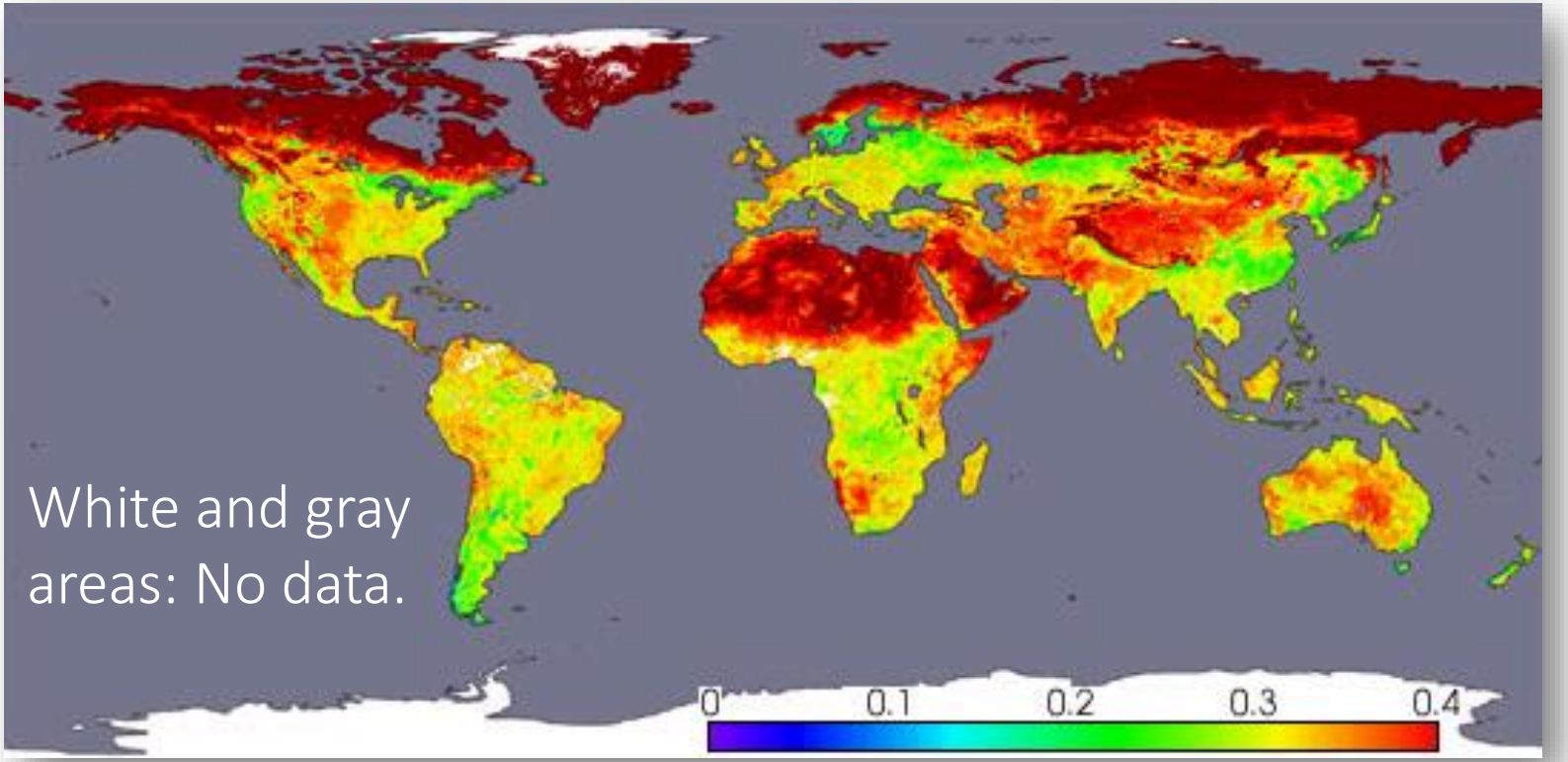
Highest Albedo?

Lowest Albedo?

Surface	Albedo[a]	
	Summer	Winter
Mixed farming, tall grass	0.16	0.18
Tall/medium grassland, evergreen shrubland	0.20	0.21
Short, grassland, meadow and shrubland	0.21	0.20
Evergreen forest (needle leaved)	0.12	0.13
Mixed deciduous, evergreen forest	0.16	0.16
Deciduous forest	0.17	0.18
Tropical evergreen broadleaved forest	0.12	0.15
Medium/tall grassland, woodland	0.15	0.18
Desert	0.36	0.36
Tundra	0.17	0.17
Snow	0.66	0.66
Sea ice	0.62	0.62
Ocean	0.07	0.07

Data taken from Briegleb *et al.* (1986).

Albedo of Earth



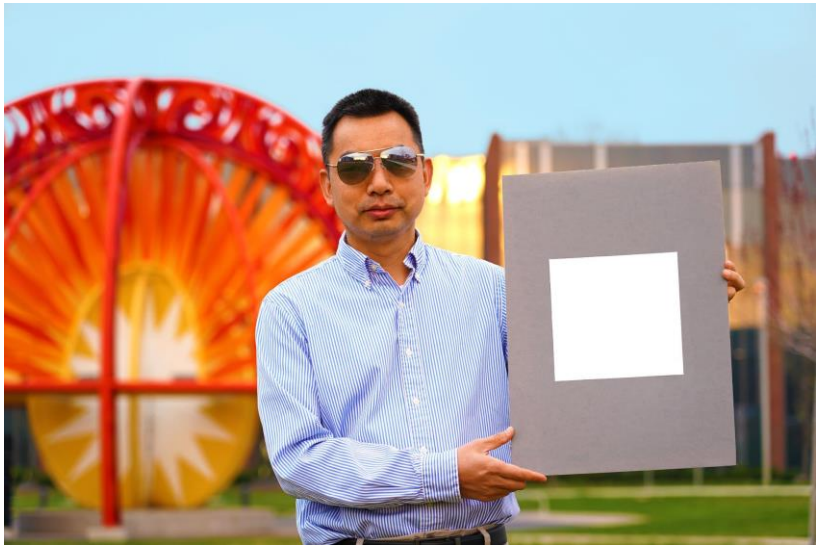
April, 2002, *Terra* satellite, NASA

Adjusting our Albedo

BUREAU OF STREET SERVICES

Los Angeles paints streets white to stay cool

By David Shultz | Sep. 7, 2017 , 5:00 PM

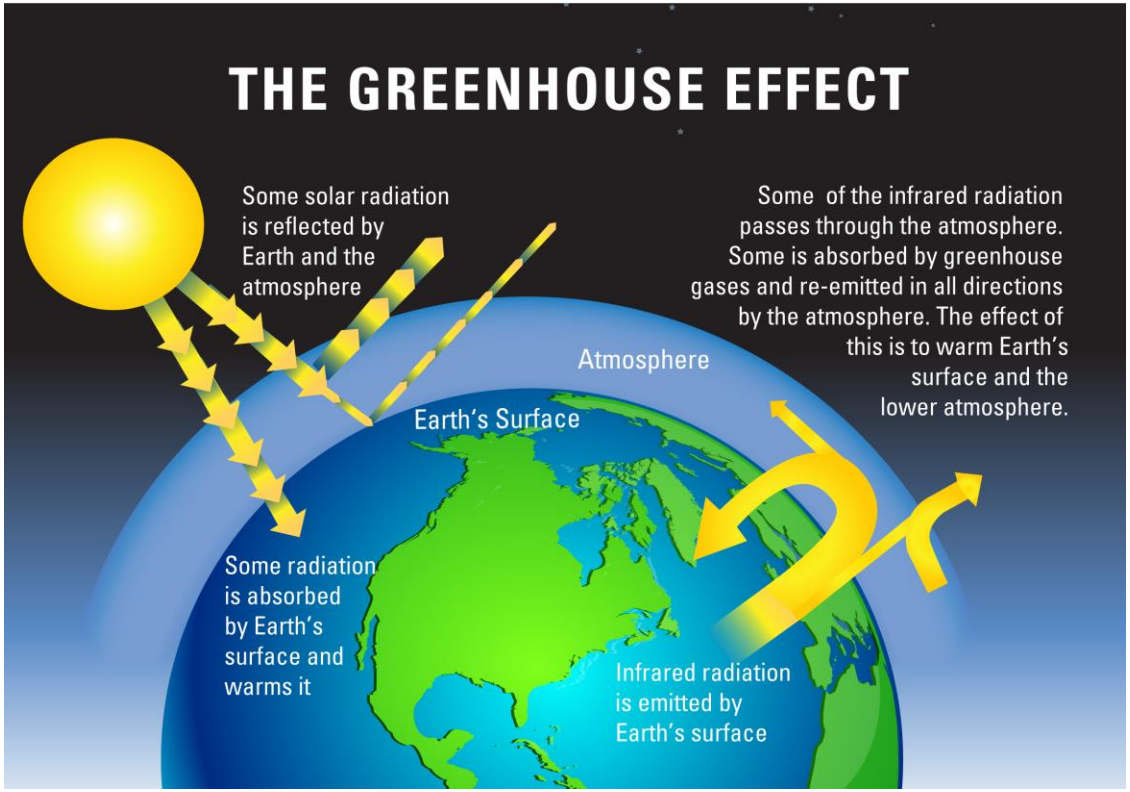


Thermal Equilibrium

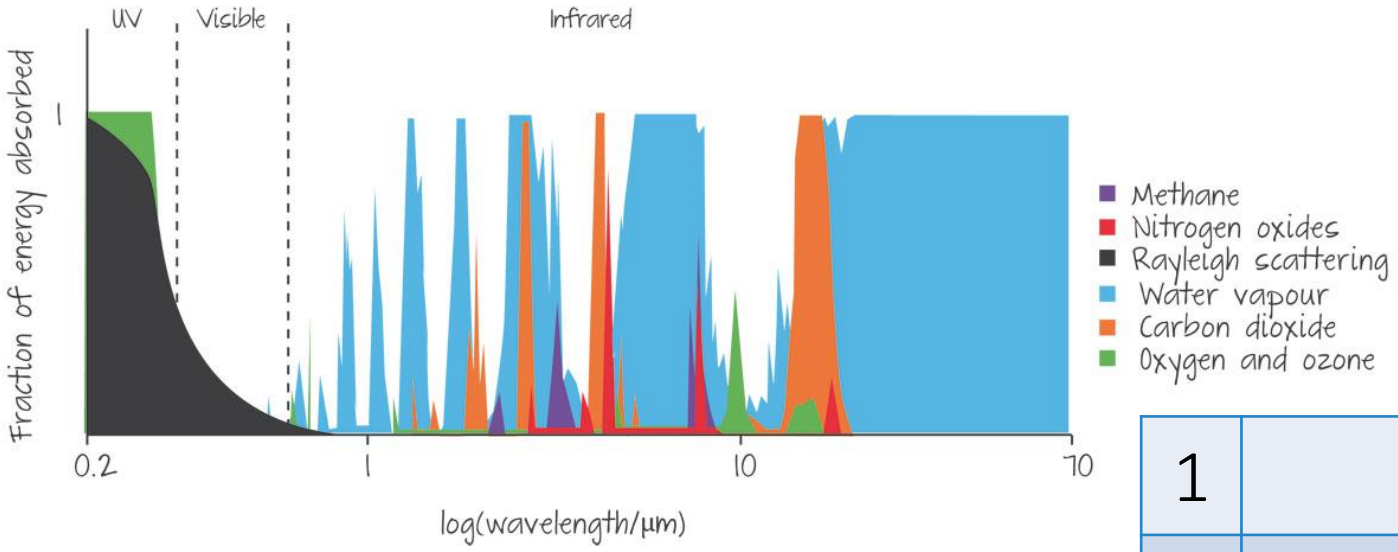
In order to maintain a constant global temperature, the Earth must emit the same amount of energy that it absorbs

Greenhouse Effect

If there was no atmosphere, the earth would experience a net loss of energy and reach equilibrium at an average temperature about 30°C colder than it is currently.



Role of the Atmosphere



Rank the following Greenhouse Gases based on the amount of infrared energy they absorb

1	
2	
3	
4	
5	

More on this later…