Poll

W

Earth's surface receives ~246 W/m2 fro sun. In our new model, the atmosphere absorbs outgoing terrestrial radiation. The amount of Earth's radiation reaching sp is now

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Greater than 246 W/m2 (since surface is warmer)

Less than 246 W/m2 (since radiation comes from a cold atmosphere)

(since the total energy emitted out to space hasn't change

Next

Previous

Total Results: 0

1-Layer model summary: much better!

1. An atmosphere that absorbs some ***OLR*** slows energy flow from the surface to space (relative to no atmosphere). **Greenhouse Effect!**

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1. An atmosphere that absorbs some ***OLR*** slows energy flow from the surface to space (relative to no atmosphere). **Greenhouse Effect!**

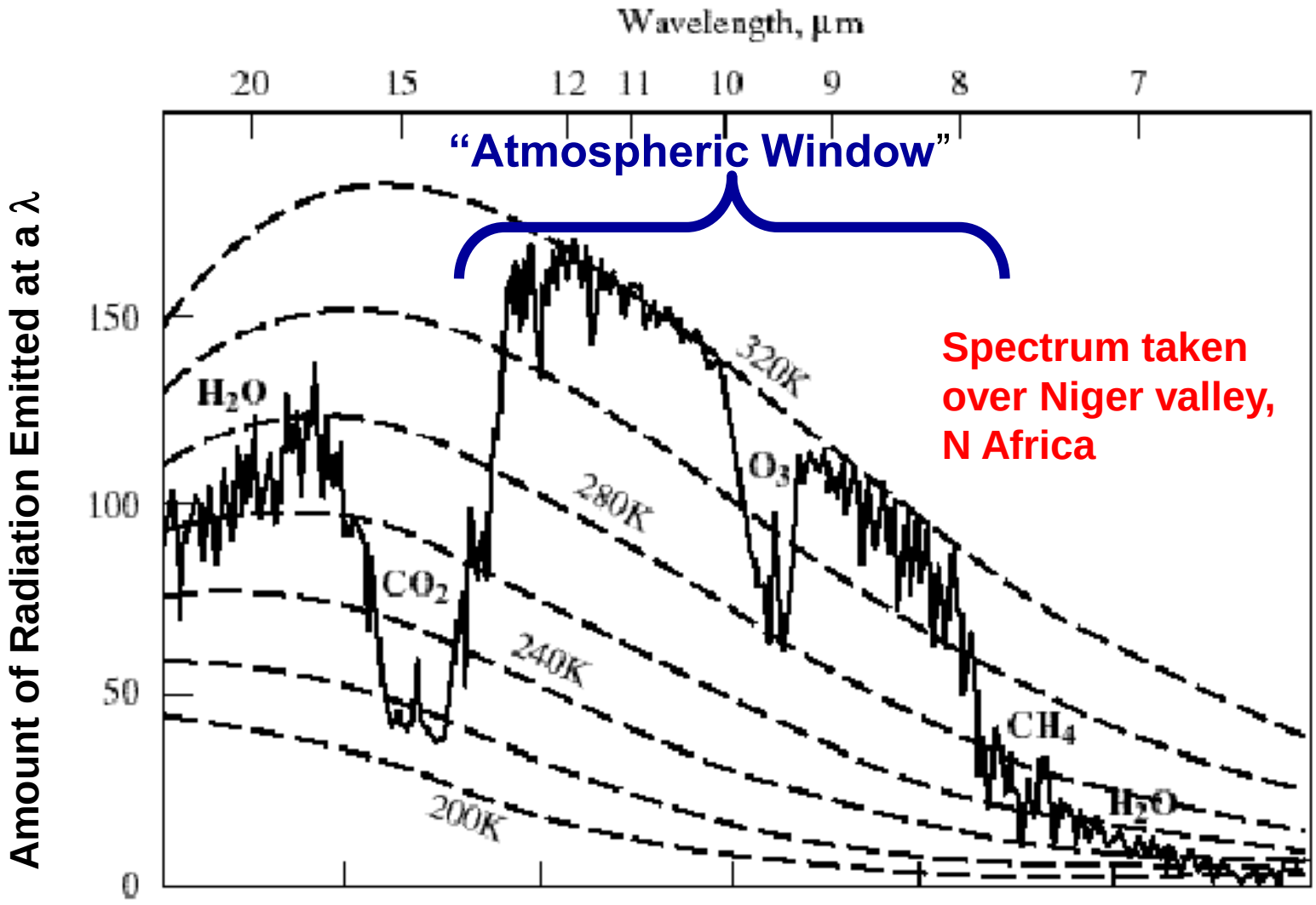
2. An ***increase*** in atmosphere's ***absorptivity*** ("epsilon") causes ***surface T*** to ***increase***.

3. Radiation reaching space from Earth is a combination of emission from a ***warm surface*** ***and*** a ***colder atmosphere***.

Total must be equivalent to ~246 W/m^2 at equilibrium.

Emission Spectrum of Earth Taken From Space

Emission from cold atmosphere and warm surface



The Greenhouse Effect

$$T_{true} - T_{\text{"bare rock"}}$$

$$289\ K - 256\ K = 33\ K$$

Definition: **Absorption of *terrestrial* outgoing long-wave radiation by the atmosphere, causing the surface T to be larger than the planet's "emission" T**

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The greenhouse effect is best described the following analogy

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An actual greenhouse

A solar powered electric water heater

Food scraps clogging a sink's drain

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Total Results: 0

A real greenhouse

Absorbed solar energy is trapped within enclosure, air inside warms.

Air stays warmer mainly because air outside is prevented from blowing through.

A greenhouse built from material with zero long-wave absorptivity works as well as one built from glass…

The Atmosphere's Greenhouse Effect

- What gases cause the GHE and why?
- Why are some GHG's better than others?

Requires understanding

– some properties of the atmosphere,
– GHG amounts and their distribution in the atmosphere
– and what wavelengths they absorb

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If the atmosphere only absorbs outgoing long-wave radiation, and it absorbs all of those wavelengths equally well, what wavelength would it most frequently be absorbing?

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- 0.1 micron
- 1 micron
- 10 micron

Next
Previous

Total Results: 0

Greenhouse Gas (GHG)

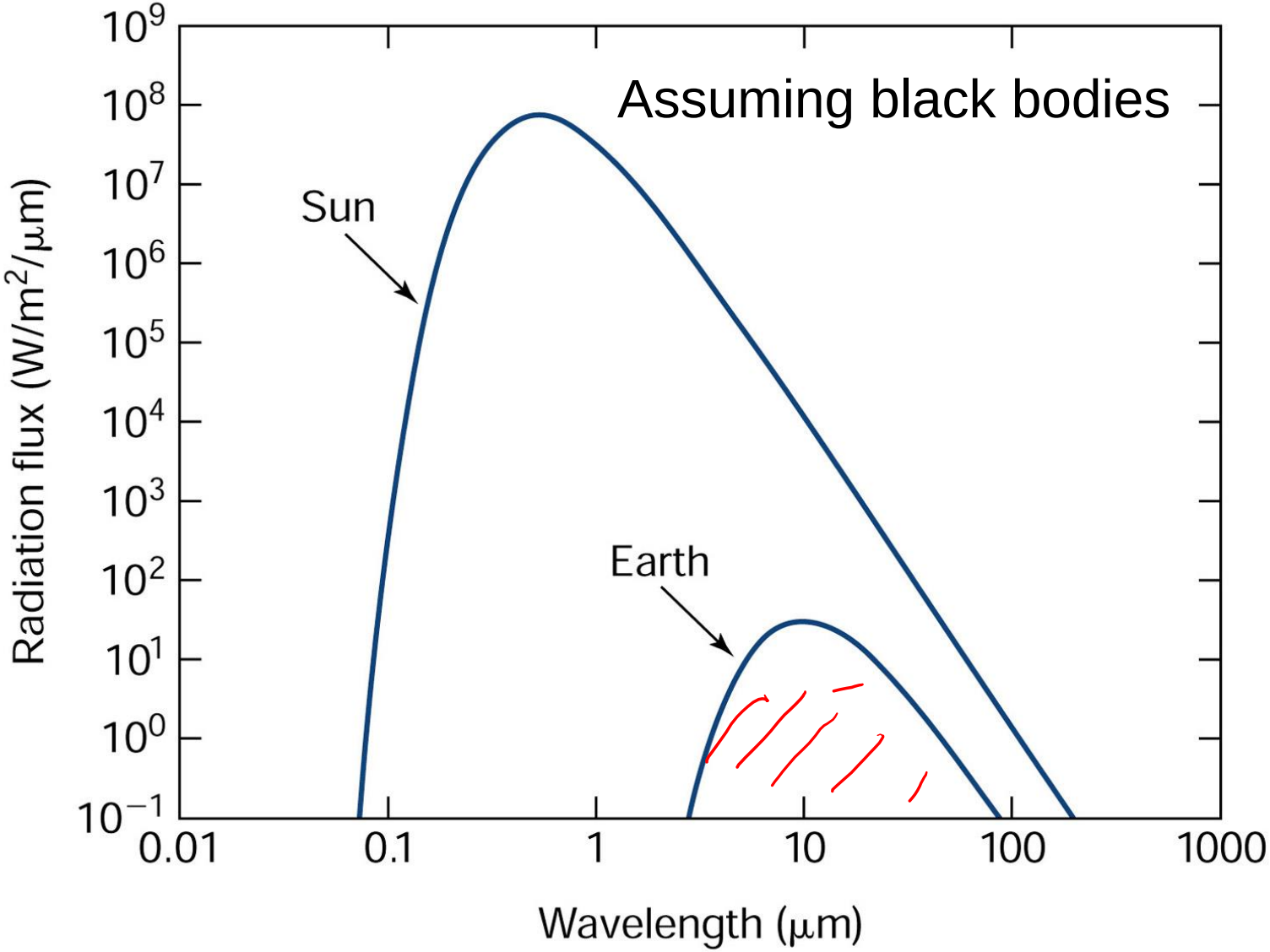
- Component of the atmosphere that absorbs **O**utgoing "**L**ong-wave" **R**adiation (**OLR**)

Most radiation (OLR) ~ 5 – 25 μm in wavelength

This mostly infrared radiation (IR)

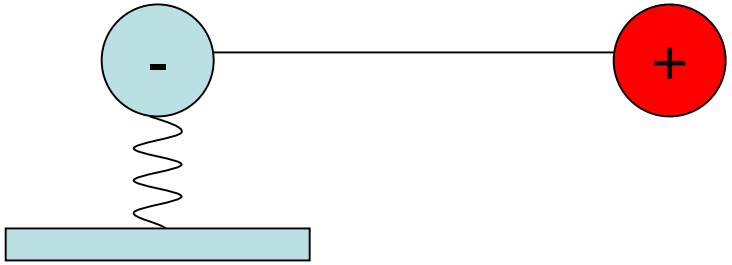
molecules must vibrate & rotate & cause disturbance in E field

Solar and Terrestrial Emission Spectra



Why are only some gases GHG?

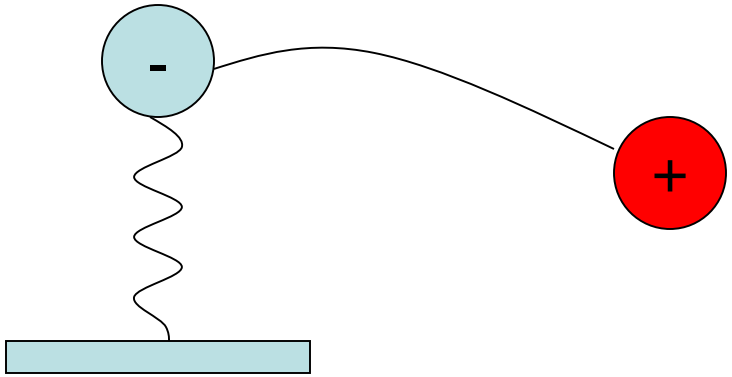
The answer lies in our analogy to charges on springs interacting with EM radiation.



Charged Particle Motion

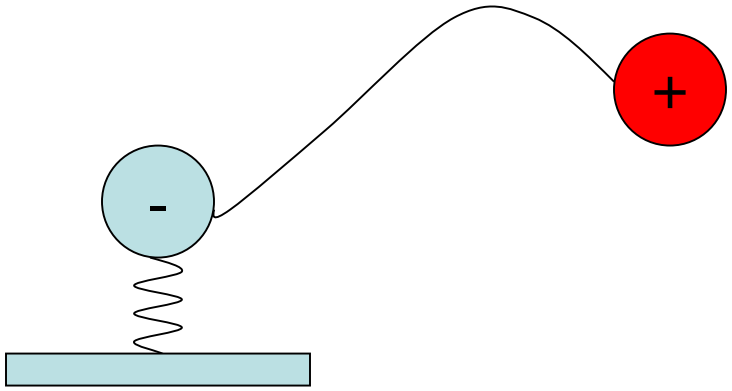
Electromagnetic field disturbance

Charged Particle Motion



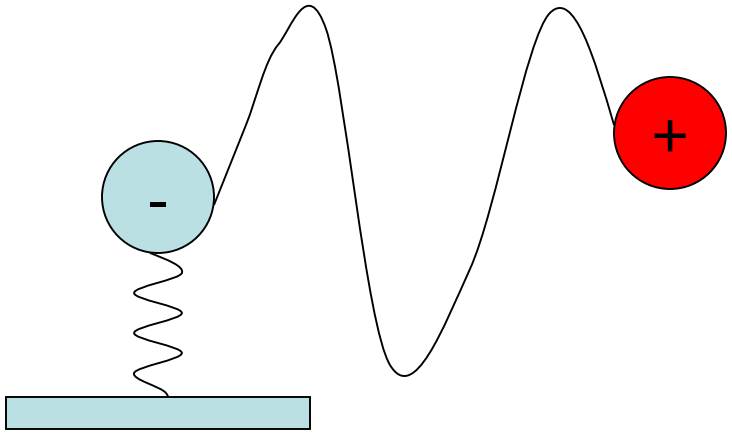
Electromagnetic field disturbance

Charged Particle Motion



Electromagnetic field disturbance

Charged Particle Motion



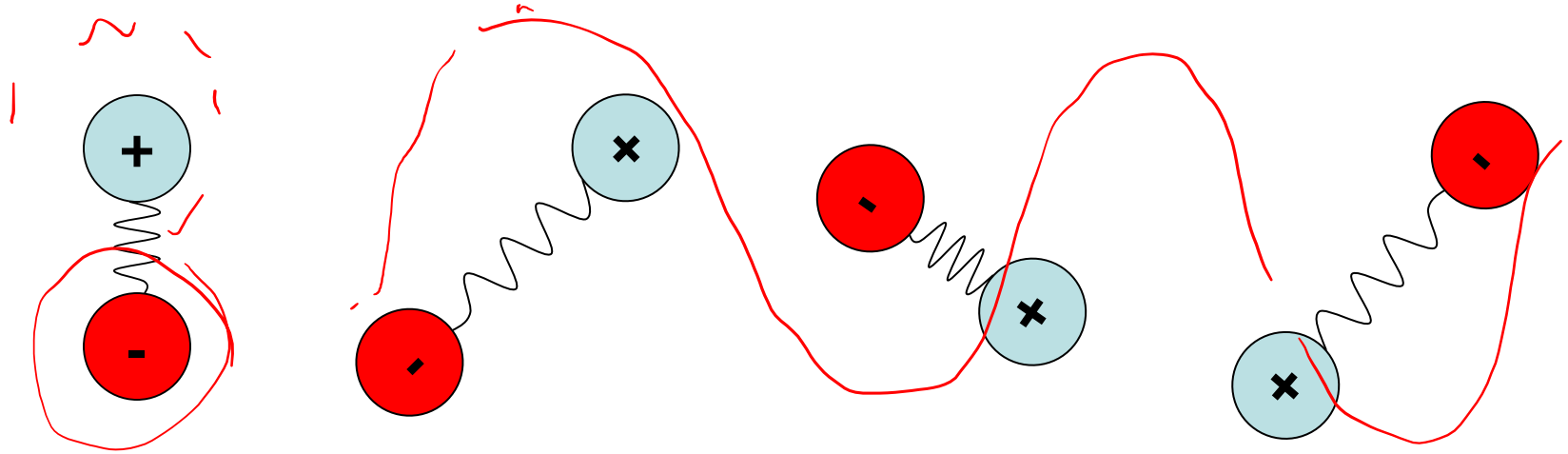
Oscillations in the electric and magnetic fields move, “radiate”, through space.

Such oscillations are known as **electromagnetic radiation (which encompasses light)**

Why are only some gases GHG?

The answer lies in our analogy to charges on springs interacting with EM radiation.

OLR is <u>InfraRed (IR) radiation</u>, which carries enough energy to make molecules vibrate and rotate.

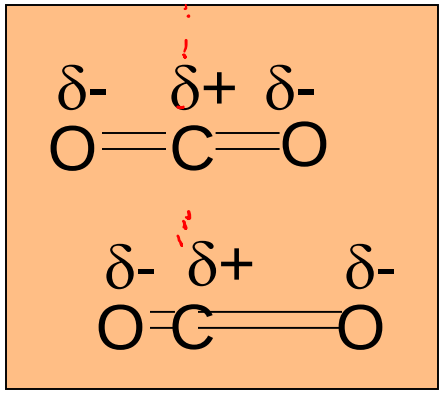


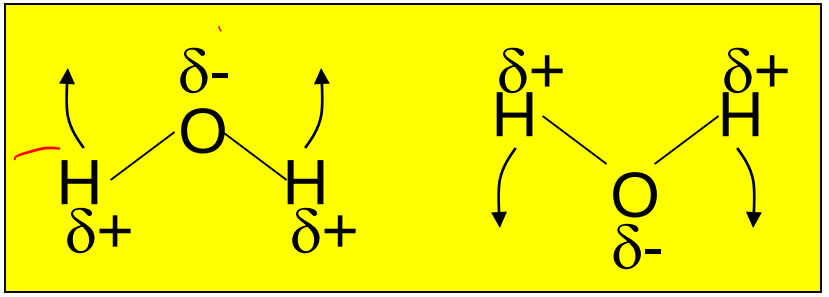
Greenhouse Gases Absorb IR Radiation

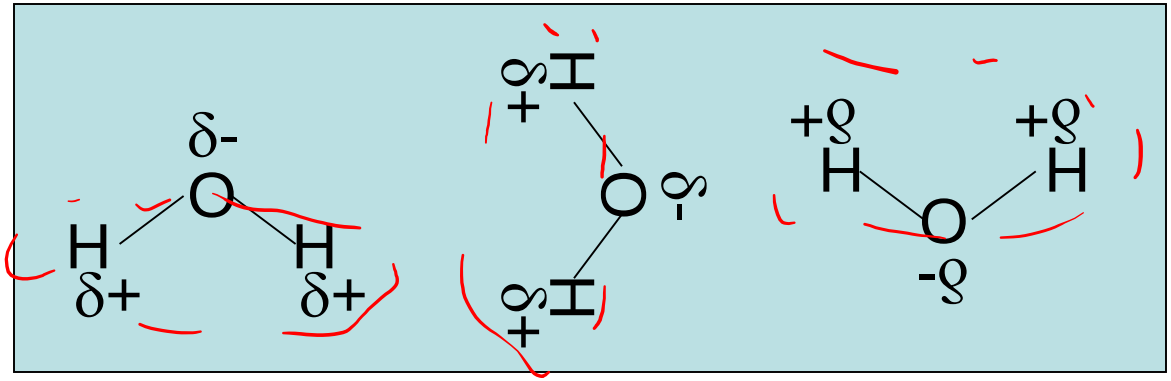
<u>Kirchoff's law</u>: to absorb radiation, the molecules must be able to emit that radiation.

For gas to absorb IR radiation, it must generate oscillations in E&M fields when it vibrates or rotates

N≡N O=O







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Chlorofluorocarbons (CFCs), once used refrigerants, propellants, etc., are excellent greenhouse gases. In the atmosphere, after a long time (100s years), they break down into other gases, including HF and F2.

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- Both HF and F2 are greenhouse gases
- HF is a greenhouse gas, but F2 is not
- HF is not a greenhouse gas, but F2 is
- Neither HF nor F2 are greenhouse gases

Next

Previous

Total Results: 0