A bright sun with prominent rays is positioned in the upper center of the frame against a clear blue sky. Below the sun, a vast expanse of water is covered with numerous icebergs of various sizes and shapes. The icebergs appear to be melting, with some showing signs of weathering and discoloration. The water is a deep blue, and the overall scene suggests a polar or subpolar environment. The text is overlaid in the center of the image.

Global Warming

Lecture 3.5

Greenhouse Gases

Emissivity review :

Most objects are not blackbodies!

At a given wavelength, a real object emits / absorbs a fraction $\epsilon_\lambda / a_\lambda$ of the radiation a blackbody would emit at a given temperature.

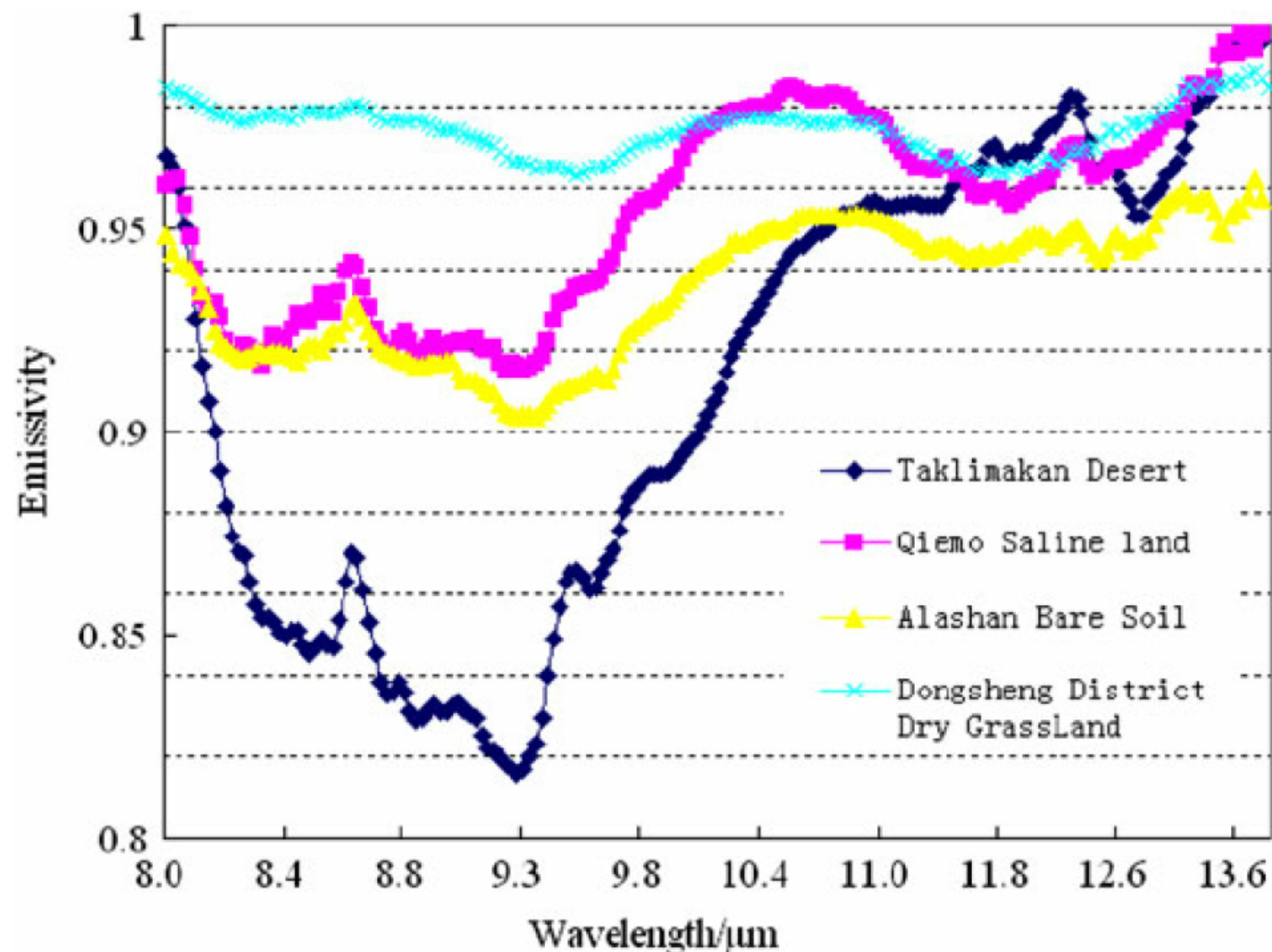
ϵ_λ = emissivity

a_λ = absorptivity

$$\mathbf{a_\lambda = \epsilon_\lambda}$$

For most solids and liquids ϵ_λ and a_λ are fairly constant with wavelength, and usually ϵ_λ and $a_\lambda \sim 1$

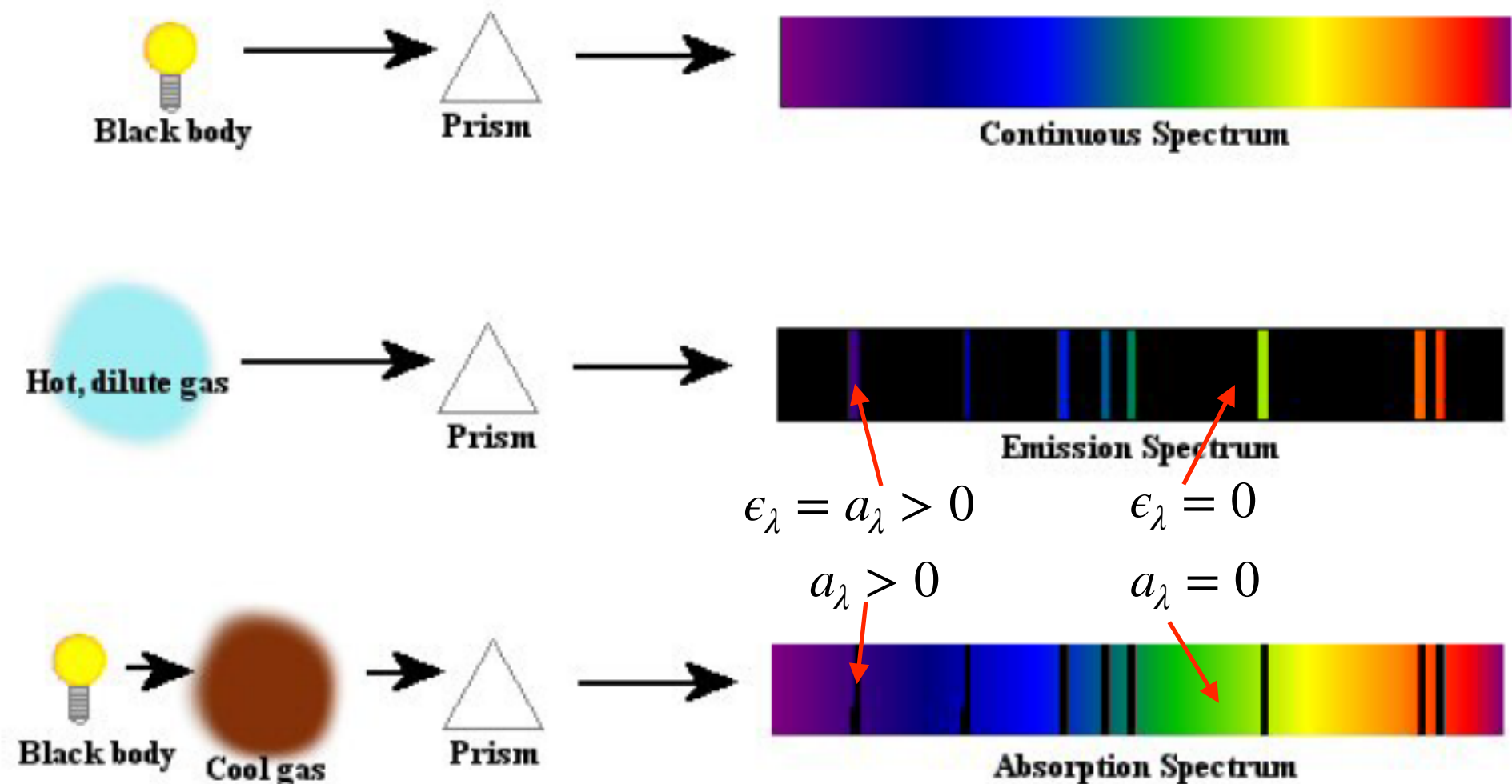
Emissivity of the land surface in different areas of China



Greenhouse gases:

Only particular frequencies/wavelengths of light can be absorbed/emitted by a particular gas.

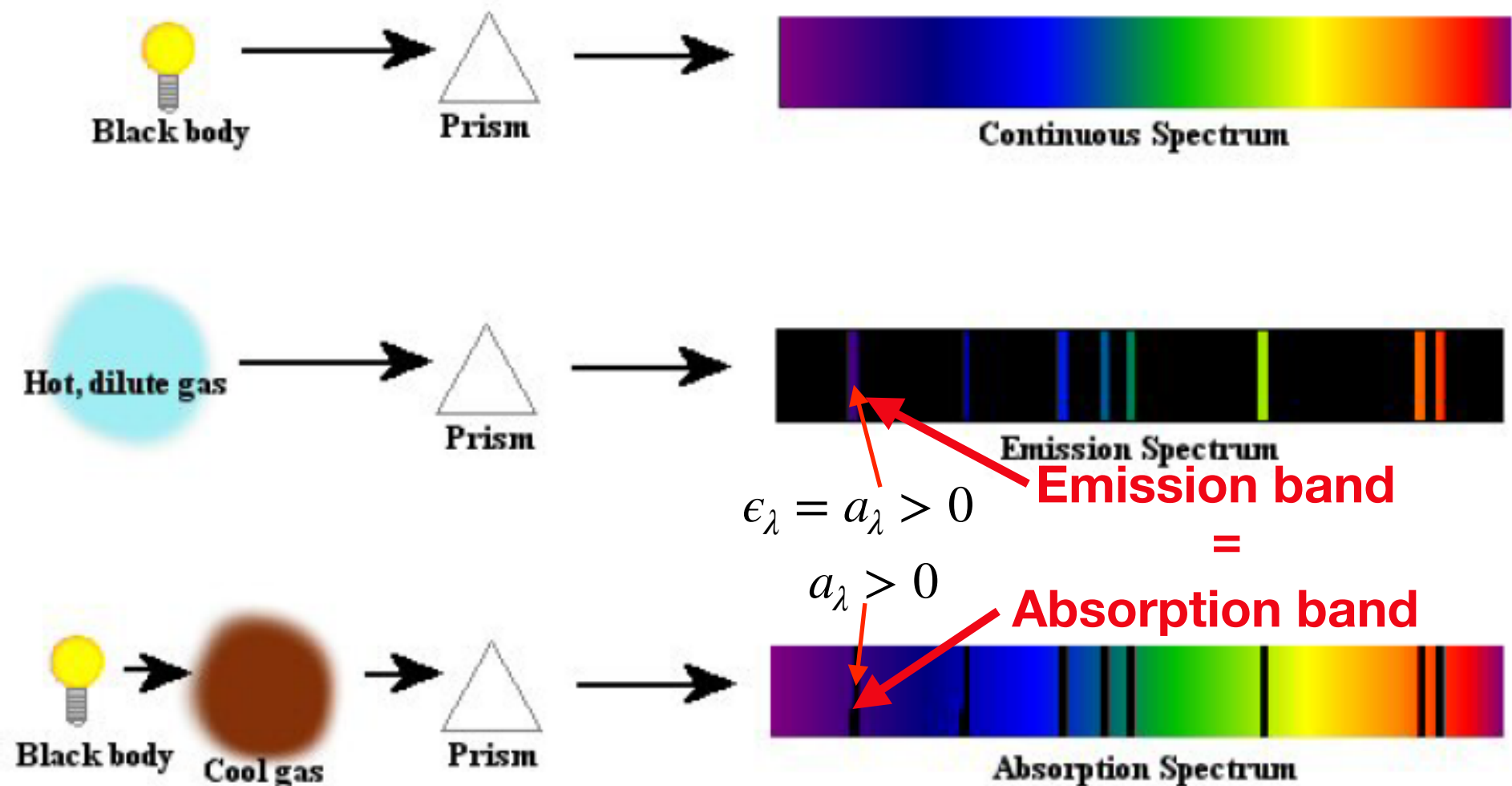
A gas emits
and absorbs
at the same
frequencies/
wavelengths



Greenhouse gases:

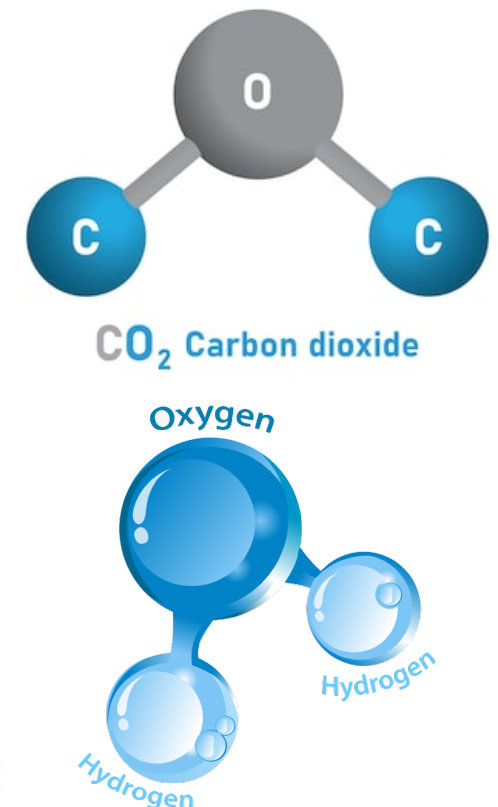
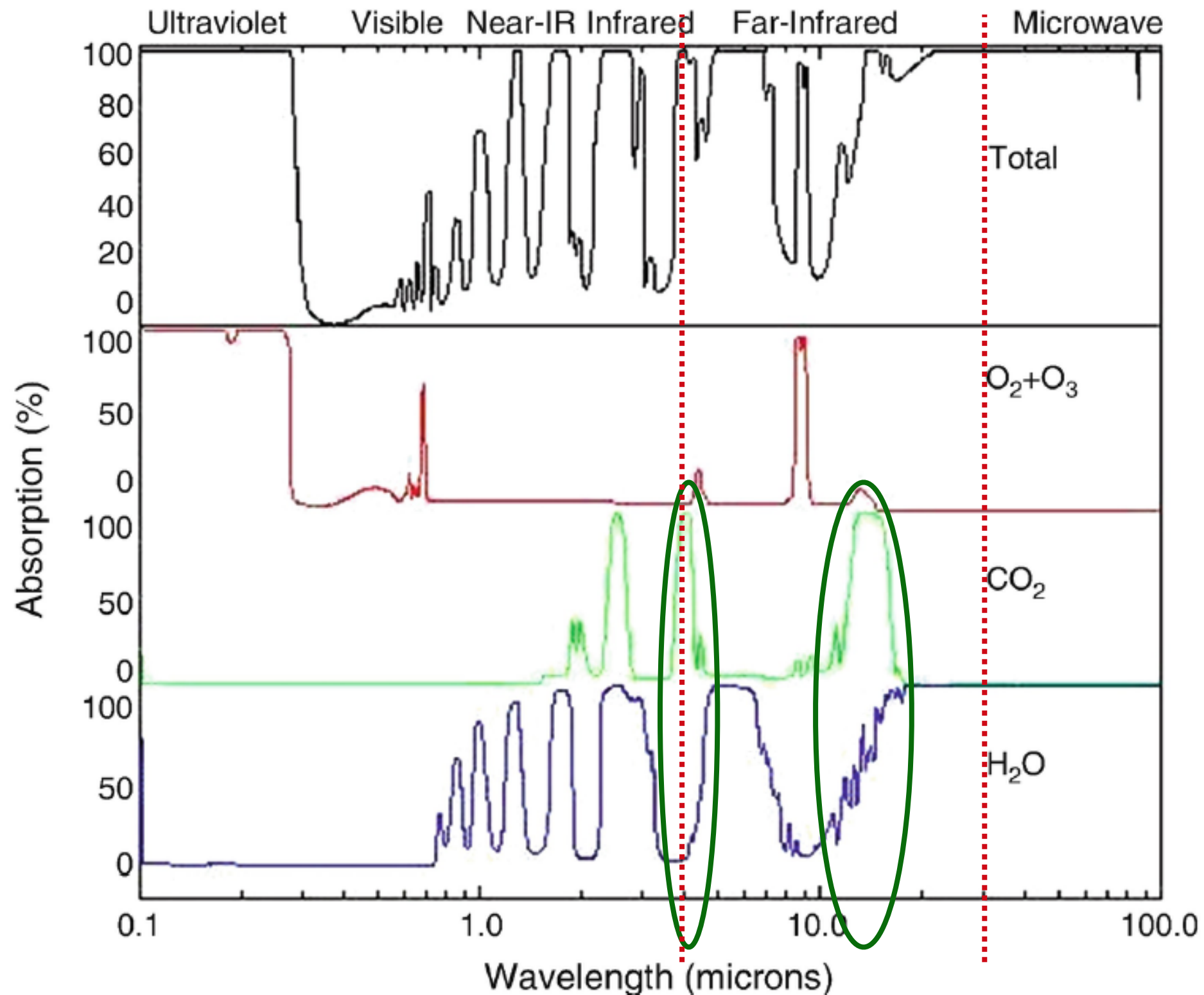
Only particular frequencies/wavelengths of light can be absorbed/emitted by a particular gas.

A gas emits
and absorbs
at the same
frequencies/
wavelengths



Important greenhouse gases:

Earth emits a lot of infrared light between 5–30 μm .



For a gas to be an important greenhouse gas on Earth, it has to:

(a) absorb strongly in some band

**(b) not have other gases absorbing strongly there
(otherwise nothing happens when you add it to
the atmosphere)**

**(c) Earth has to be emitting a lot of
electromagnetic radiation in that band for the gas
to block**