Lecture 4. Atmospheric Absorption of Radiation

- The atmosphere absorbs little (5%) of radiation in visible wavelengths
- Stratospheric ozone absorbs almost all UV radiation
- Water vapor, CO_2, methane, nitrous oxide, ozone, and CFCs all absorb some of the infrared radiation emitted by the earth, and are called greenhouse gases.

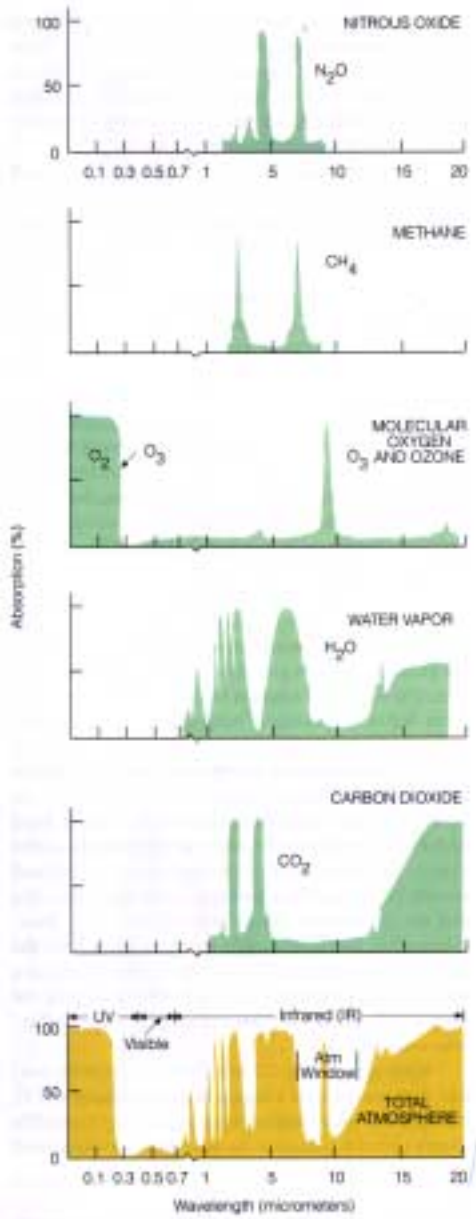
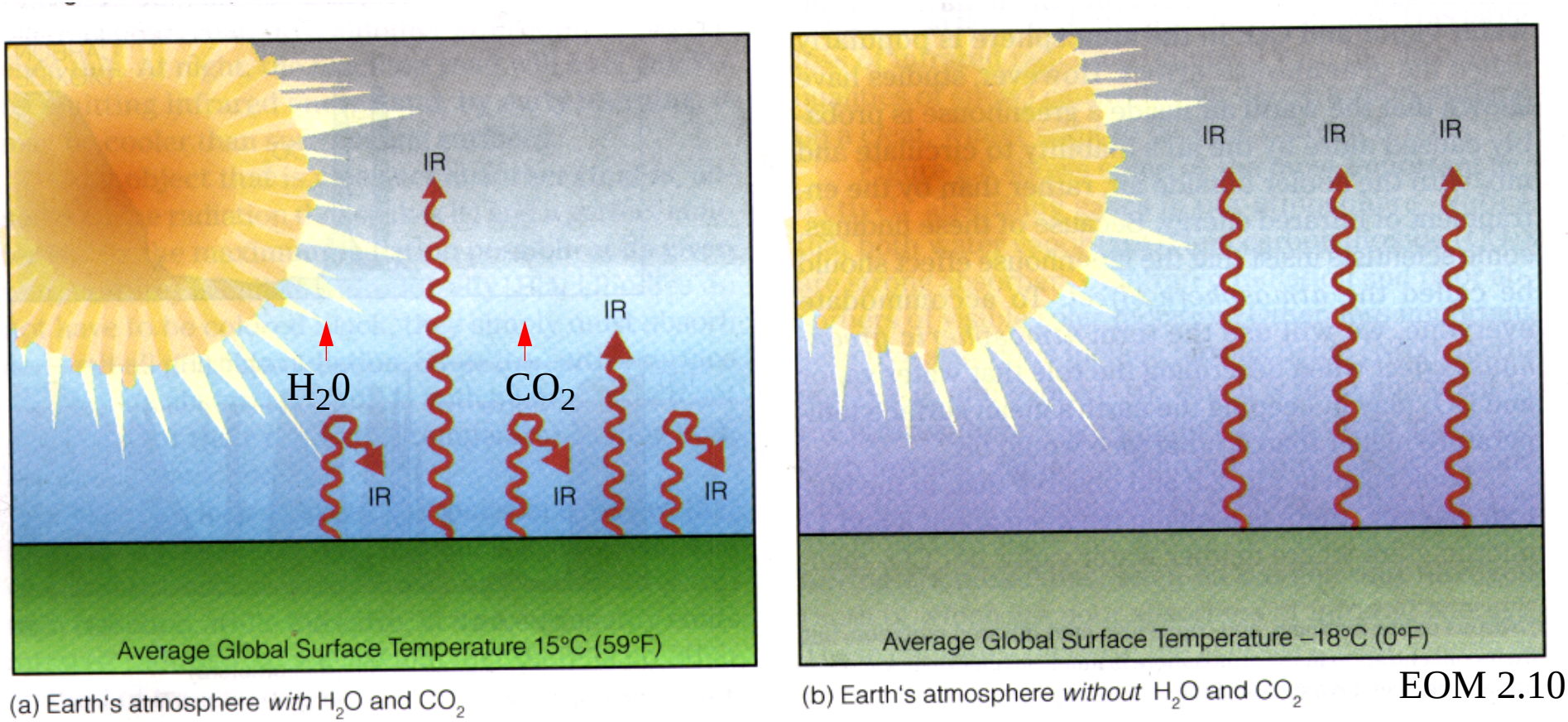


FIGURE 2.9
Absorption of radiation by gases in the atmosphere.

EOM 2.9

The Greenhouse Effect



(a) Earth's atmosphere *with* H_2O and CO_2

(b) Earth's atmosphere *without* H_2O and CO_2

EOM 2.10

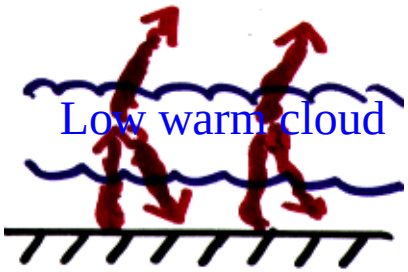
- Greenhouse gases absorb and emit infrared (IR, also called longwave) radiation. Some of this IR radiates downward, warming the surface.
- No greenhouse effect $\Rightarrow$ Earth's surface would average a frigid -18°C (0°F).
- Water vapor, clouds, and CO_2 (in that order) produce the most greenhouse warming, raising Earth's mean surface temperature to 15°C (59°F).

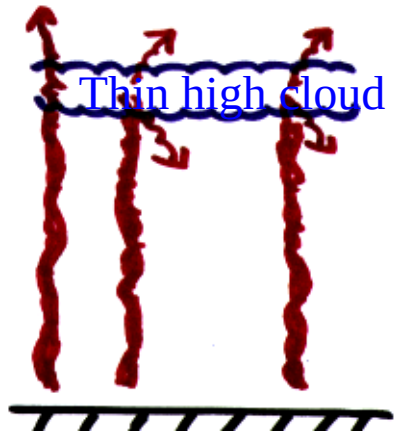
Clouds' Greenhouse Effect

- Cloud reflects visible light but strongly absorbs IR radiation, so also has greenhouse effect.

  Low, warm cloud radiates lots of IR groundward (and upward)⇒ large surface greenhouse effect

  High, cold cloud radiates less IR groundward (and upward)⇒ less surface greenhouse effect





- Thus surface temperature tends to cool much less on a night with low or thick clouds.
- Note: Real greenhouses don't work like the 'greenhouse effect'! They trap absorbed heat by suppressing air exchange with the outside.
- IR satellite images show upwelling IR. White ⇒ low IR, i. e. high, cold cloud. Grey ⇒ low, warmer, cloud. Black ⇒ clear, can see surface (which is usually warmer than clouds).