Absorption of Incoming Solar Radiation, Various Gases Including CO2

(Excerpt from "Climate Change: The Facts—2020," Chapter 11 [Dr. Geoffrey Duffy], pages 172-3. Scroll down for graph.)

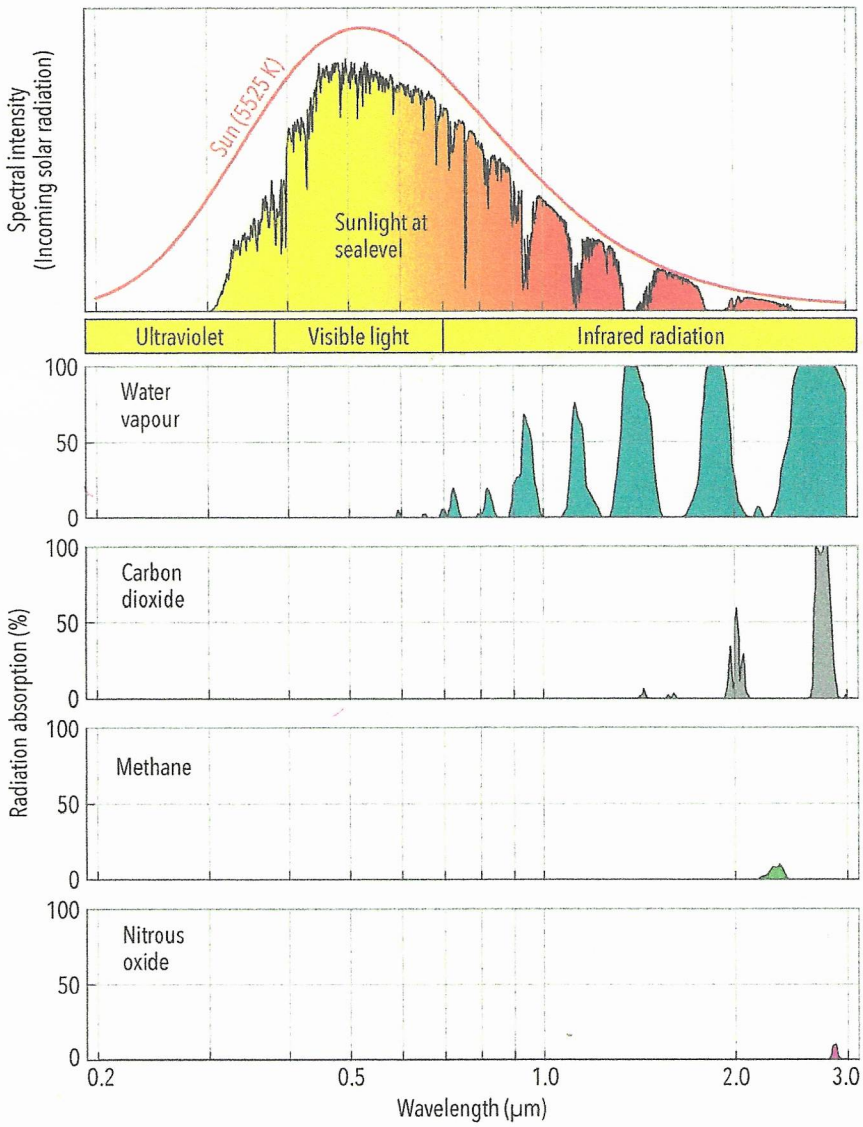
Absorption of radiation

How much electromagnetic energy does each greenhouse gas actually absorb and re-radiate? Figure 11.3 shows the radiation transmitted by the atmosphere as ultraviolet (UV), visible light and infrared radiation. Clearly, as shown in this graph, our atmospheric gases only absorb in part of the overall range between about 0.6 and 3.0 micrometres. The height of each peak denotes the quantity of solar radiant energy that each gas can possibly absorb over that specific wavelength peak range. The width of each graphical peak clearly shows the wavelength range over which the particular greenhouse gas is solar radiant energy active.

For CH_4 and nitrous oxide (N_2O), the absorption peaks are both extremely small (less than 10% absorption peaks) and are very narrow. This shows CH_4 and N_2O are almost immune or unreactive to all incoming solar radiation. CO_2 only has two absorption peaks and only one potentially can absorb 100% across a narrow wavelength band. This peak also coincides with the wide and strong water vapour peak, and hence it would have to compete with the far larger amount of water vapour in the atmosphere. In contrast, water vapour has seven absorption peaks, three operating at 100% level and wider than all others, and two more above the 50% absorption level.

It can be concluded that for incoming solar energy, water vapour is the dominant absorbing greenhouse gas. Based on the total energy absorbed (relative total area under the curve), water vapour is five times greater in absorptive ability than CO_2. As shown, the absorption potentials of both CH_4 and N_2O are miniscule, or virtually non-existent.

Figure 11.3 Absorption of incoming solar radiation



Emissive spectral density of the sun (5525 red curve), and the spectral density (solid yellow-red envelope) for radiant energy arriving in the atmosphere. The electromagnetic wavelength range for solar energy covers the range from 0.2 to 3.0 micrometres. Each greenhouse gas is labelled alongside its respective absorption spectrum in the bottom four panels.

Source: Adapted from Robert A. Rohde, Wikimedia commons.