

Visualizing CO2 Levels

Ron Rivest, MIT, 5/22/2019

<https://people.csail.mit.edu/rivest/CO2height.pdf>

We explore a way to visualize the amount of CO2 in the atmosphere by graphically showing the answer to the question:

Question: If all the CO2 in the atmosphere were collected in a layer at the bottom, how high would it be?

We may hear that the level of CO2 in the atmosphere “now exceeds 410 parts per million (ppm)”. I find this phrasing hard to grasp. How much is that, really? Guesstimate!

Answer: The atmosphere gets less dense as you go higher. If that didn’t happen, and the atmosphere had uniform density, then the atmosphere would have a height of 8.50 km (27,900 ft). [See https://en.wikipedia.org/wiki/Atmosphere_of_Earth]

Multiplying that height by 0.000410 (that is, 410 ppm), we obtain the answer to our question:

$$8.50 \text{ km} * 0.000410 = \mathbf{3.485 \text{ meters (137 inches, or 11 feet 5 inches)}}$$

Thus, if all of the CO2 in the atmosphere fell down into a single layer resting on the ground, it would be a bit more than 11 feet high. This is our “**CO2 height**” today.

Note the simple nearly exact rule of thumb:

The CO2 ppm, divided by three, is the CO2 height in inches.

Example: 410 ppm corresponds to $410 / 3 \approx 137$ inches

(Check: $8.5 \text{ km} * 0.000003 * 100000 \text{ cm/km} / 2.54 \text{ cm/inch} = 1.00393$ inches.)

This question and answer puts the amount of CO2 in the atmosphere onto a human scale; nice!

Here's a chart showing how the answer varies over time (with suggested colors for visuals):

Color	When	CO2 ppm	CO2 Height
Black	2100?	800	267 inches (22 feet 3 inches; 6.78 meters)
Red	2050?	500	167 inches (13 feet 11 inches; 4.25 meters)
Neon Orange	2019	410	137 inches (11 feet 5 inches; 3.49 meters)
Yellow	1988	350	117 inches (9 feet 9 inches; 2.98 meters)
Green	1950	310	103 inches (8 feet 7 inches; 2.64 meters)
Blue	1850	290	97 inches (8 feet 1 inch; 2.47 meters)
Blue	1750	280	93 inches (7 feet 9 inches; 2.38 meters)

See <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>

Or <https://www.co2levels.org/>



Put colored duct tape at the above heights on your favorite building, tree, or lamp-post. Post a picture of the result somewhere with hashtag **#CO2height**.

Experiment with the best way to educate / inform / express your concerns!