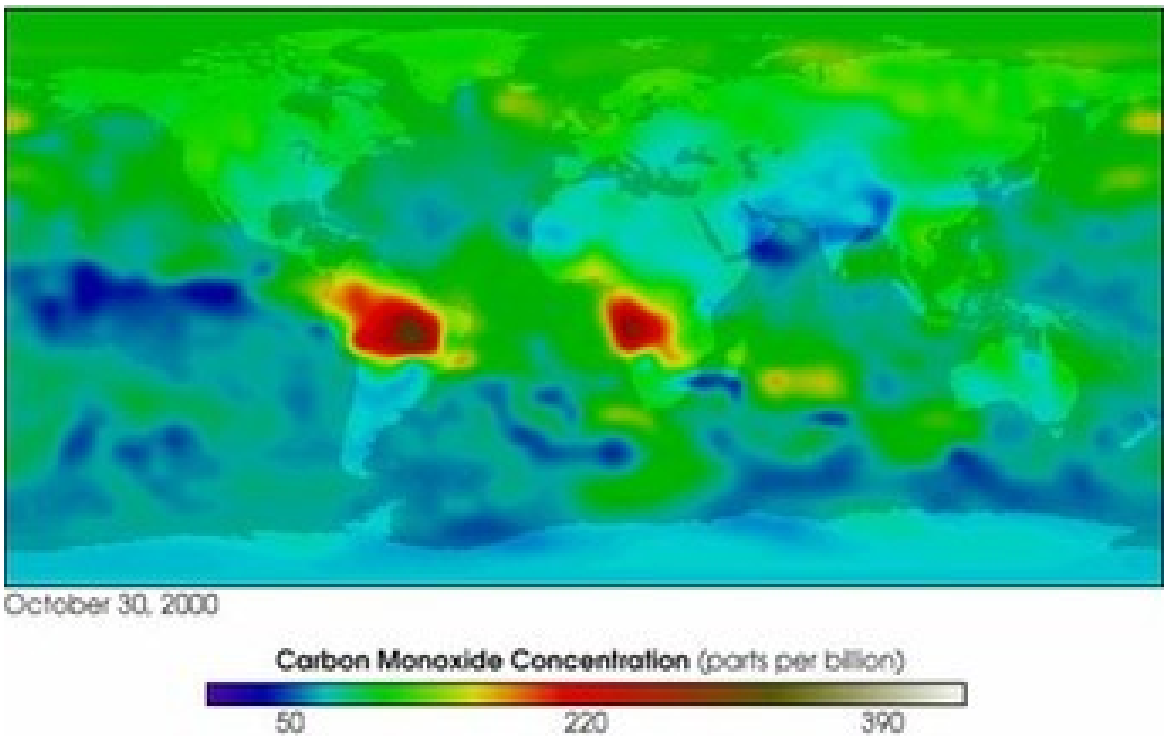
Carbon Monoxide - A Deadly Trace Gas



The NASA Terra satellite has created this map of carbon monoxide in the lower atmosphere using the MOPITT instrument, and for the first time allows scientists to study the sources and movements of large concentrations of this harmful gas. Carbon monoxide is usually associated with forest fires in the natural setting, although fall leaf decomposition accounts for 20% of the annual natural production. The false-colors in this image show the concentration of carbon monoxide in units of parts-per-billion (ppb). They range from 390 ppb (dark brown) and 220 ppb (red) to 50 ppb (blue). One ppb means that there is one molecule of carbon monoxide (CO) for every one billion other atoms of molecules of the other atmospheric constituents (mostly nitrogen and oxygen).

Problem 1 - Geographically, where are the largest producers of carbon monoxide on Earth, and why do you think this is the case?

Problem 2 - The total mass of carbon monoxide in the entire atmosphere is 550 million tons (500 megatons), with an average concentration of 100 ppb as shown by the large amount of 'green' in the Terra map. The atmosphere has a surface density of 10 megatons/km^2. Assuming that the entire amount of CO in the anomaly was released in one day, if the total area involved in the Amazon Basin and African fires is about 20 million km^2, at a concentration of 230 ppb, what is the total mass of carbon monoxide released into the atmosphere by these fires in A) one day? B) one year?

Problem 1 - Geographically, where are the largest producers of carbon monoxide on Earth, and why do you think this is the case?

Answer: **These producers are in the Amazon Basin and sub-Saharan Africa. These are known to be regions where farmers routinely burn down forests to create farmland for livestock and crops.**

Problem 2 - The total mass of carbon monoxide in the entire atmosphere is 550 million tons (500 megatons), with an average concentration of 100 ppb as shown by the large amount of 'green' in the Terra map. The atmosphere has a surface density of 10 megatons/km^2. Assuming that the entire amount of CO in the anomaly was released in one day, if the total area involved in the Amazon Basin and African fires is about 20 million km^2, at a concentration of 230 ppb, what is the total mass of carbon monoxide released into the atmosphere by these fires in A) one day? B) one year?

Answer: The total atmospheric mass over these two regions is 10 megatons/km^2 x 20 million km^2 = 200 million million tons or 200,000 gigatons.

From the concentration of carbon monoxide as 230 ppb, the normal concentration is only 100 ppb, so the fires contribute 230-100 = 130 ppb additional carbon monoxide.

A) Since the total atmospheric mass over these two regions is 200,000 gigatons at an average of 100 ppb, the amount of excess carbon monoxide is

200,000 gigatons x (130 /100) x (1/1 billion) = **260,000 tons in one day**.

B) Multiplying the daily release in the map by 365 days/year gives 365 x 260,000 tons = **95 megatons/year**….but these fires may not burn all year long.