

8.1: Climate Science And Carbon Dioxide

Carbon dioxide (CO₂) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions. Figure 8.1.1 shows CO₂ levels during the last three glacial cycles, as reconstructed from ice cores, as well as direct measurements from 2002-2024.

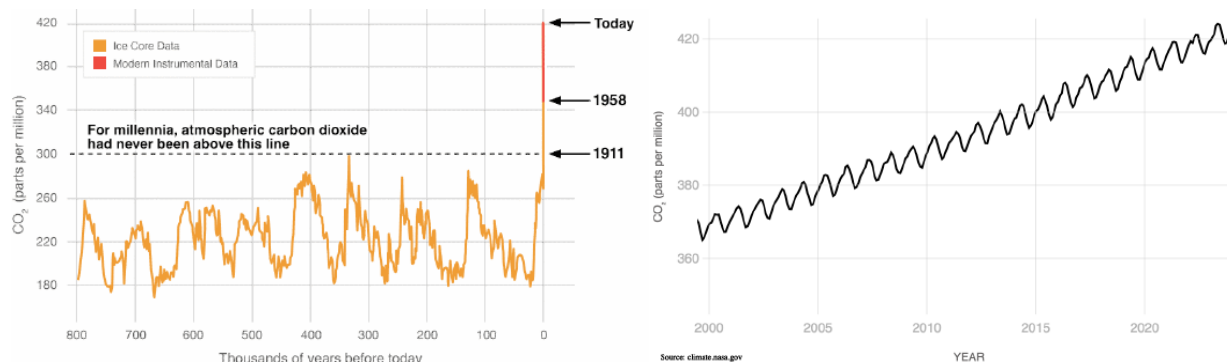
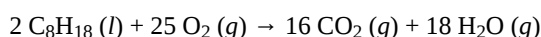


Figure 8.1.1: Atmospheric CO₂ concentrations based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO₂ has increased since the Industrial Revolution. Data as of April 2024. (Credit NOAA via [NASA](#))

Carbon dioxide, CO₂, is the primary greenhouse gas emitted through human activities. In 2015, CO₂ accounted for about 82.2% of all U.S. greenhouse gas emissions from human activities. Carbon dioxide is naturally present in the atmosphere as part of the Earth's carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals). Human activities are altering the carbon cycle, both by adding more CO₂ to the atmosphere and by influencing the ability of natural sinks, like forests, to remove CO₂ from the atmosphere. While CO₂ emissions come from a variety of natural sources, human-related emissions are responsible for the increase that has occurred in the atmosphere since the industrial revolution.

The main human activity that emits CO₂ is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation, although certain industrial processes and land-use changes also emit CO₂. As an example of how CO₂ can be generated, consider the combustion of octane, a component of gasoline:



This balanced reaction demonstrates that for every two molecules of octane that are burned, 16 molecules of CO₂ are generated.

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