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Earth System Research Laboratory (https://www.esrl.noaa.gov)

Global Monitoring Division (/gmd/)

Global Greenhouse Gas Reference Network
(/gmd/ccgg/)

(/gmd/webdata/ccgg/trends/rss.xml)

Trends in Atmospheric Carbon Dioxide

Mauna Loa, Hawaii (mlo.html) Global (global.html) CO_2 Animation (history.html)

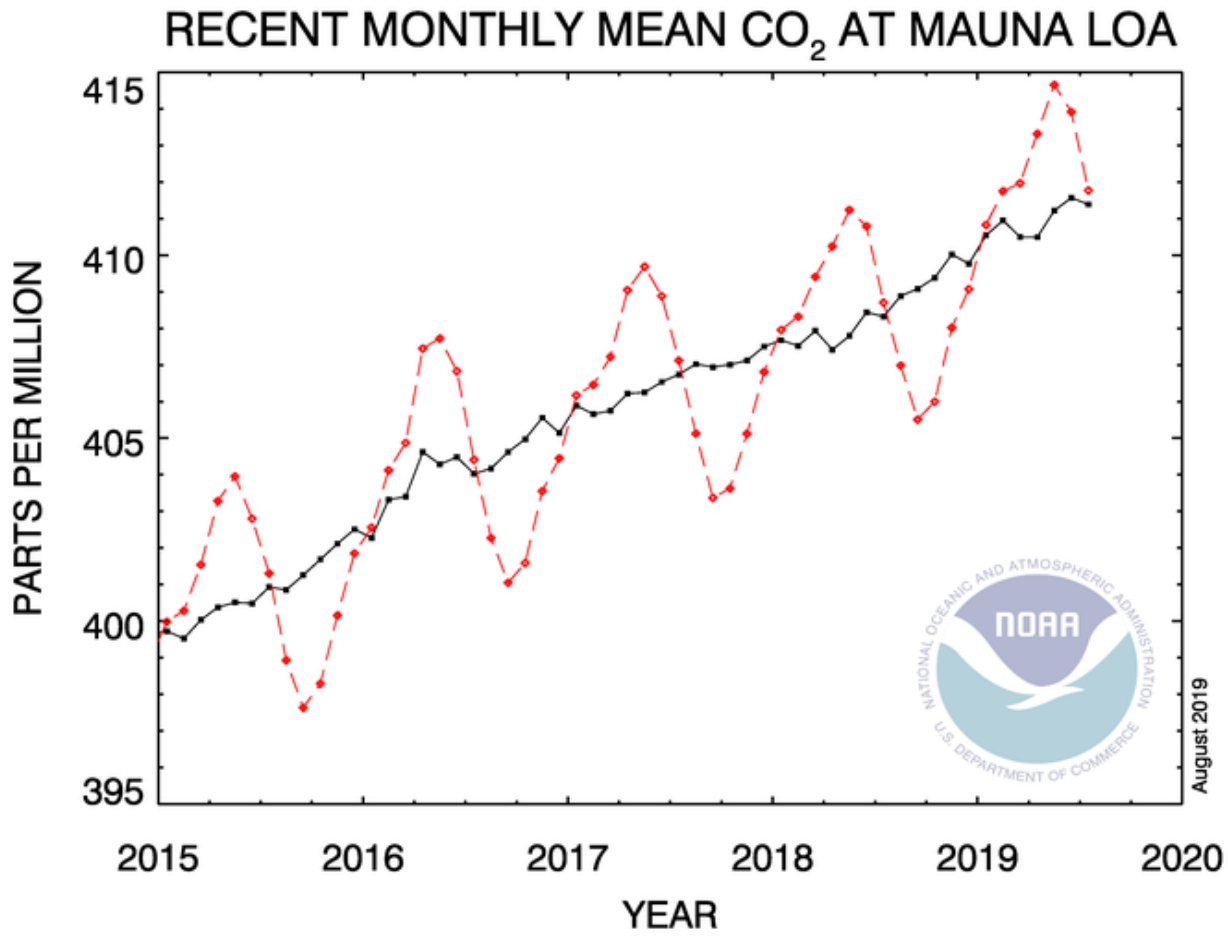
CO_2 Emissions (ff.html)

- Last Month (monthly.html)
- Last 1 Year (weekly.html)
- Full Record (mlo.html)
- Growth Rate (gr.html)
- Data (data.html)
- Interactive Plots (graph.html)

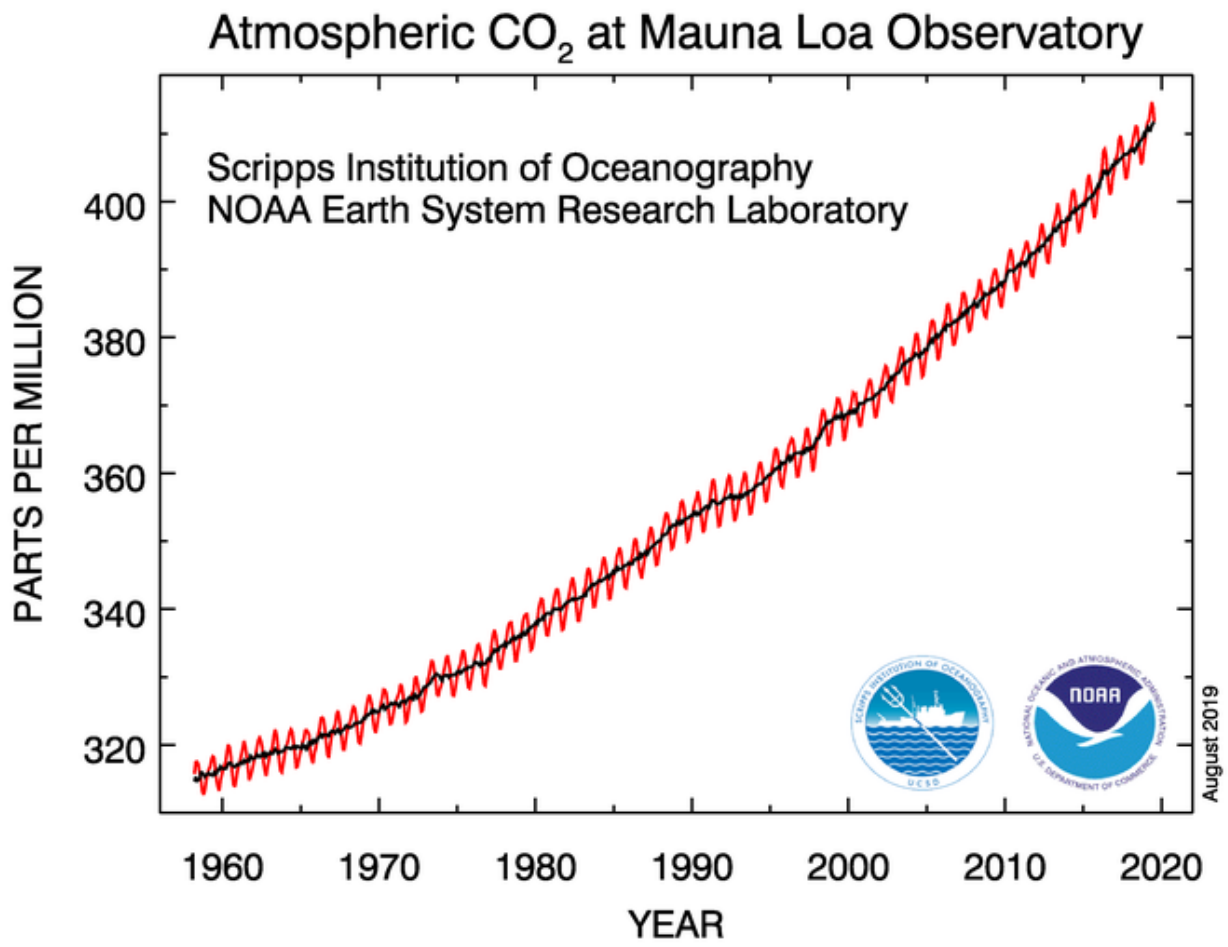
Monthly Average Mauna Loa CO_2

July 2019: 411.77 ppm
July 2018: 408.71 ppm

Last updated: August 5, 2019



PNG Version (/gmd/webdata/ccgg/trends/co2_trend_mlo.png) PDF Version (/gmd/webdata/ccgg/trends/co2_trend_mlo.pdf)



PNG Version (/gmd/webdata/ccgg/trends/co2_data_mlo.png) PDF Version (/gmd/webdata/ccgg/trends/co2_data_mlo.pdf)

The graphs show monthly mean carbon dioxide measured at Mauna Loa Observatory, Hawaii. The carbon dioxide data (red curve), measured as the mole fraction in dry air, on Mauna Loa constitute the longest record of direct measurements of CO_2 in the atmosphere. They were started by C. David Keeling of the Scripps Institution of Oceanography in March of 1958 at a facility of the National Oceanic and Atmospheric Administration *[Keeling, 1976]*. NOAA started its own CO_2 measurements in May of 1974, and they have run in parallel with those made by Scripps since then *[Thoning, 1989]*.

The last four complete years of the Mauna Loa CO_2 record plus the current year are shown in the first graph. The full record of combined Scripps data and NOAA data are shown in the second graph. The dashed red lines with diamond symbols represent the monthly mean values, centered on the middle of each month. The **black lines** with the square symbols represent the same, after correction for the average seasonal cycle. The latter is determined as a moving average of SEVEN adjacent seasonal cycles centered on the month to be corrected, except for the first and last THREE and one-half years of the record, where the seasonal cycle has been averaged over the first and last SEVEN years, respectively.

The last year of data are still **preliminary**, pending recalibrations of reference gases and other quality control checks. Data are reported as a dry air mole fraction defined as the number of molecules of carbon dioxide divided by the number of all molecules in air, including CO_2 itself, after water vapor has been removed. The mole fraction is expressed as parts per million (ppm). Example: 0.000400 is

expressed as 400 ppm. The Mauna Loa data are being obtained at an altitude of 3400 m in the northern subtropics, and may not be the same as the **globally averaged CO_2 concentration at the surface** (global.html#global).

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