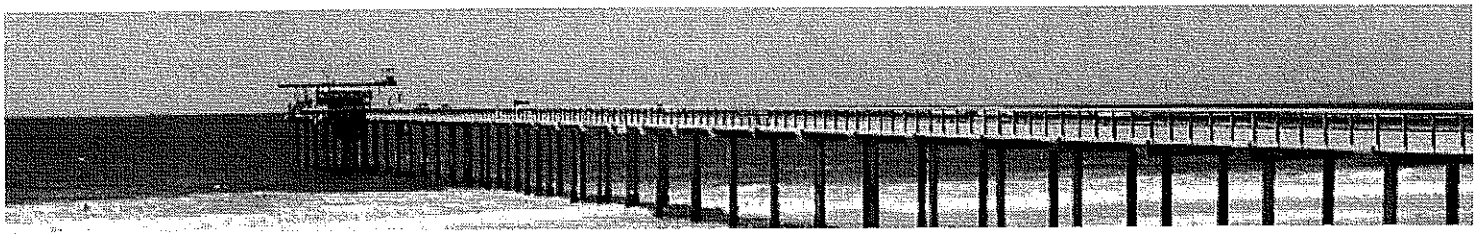

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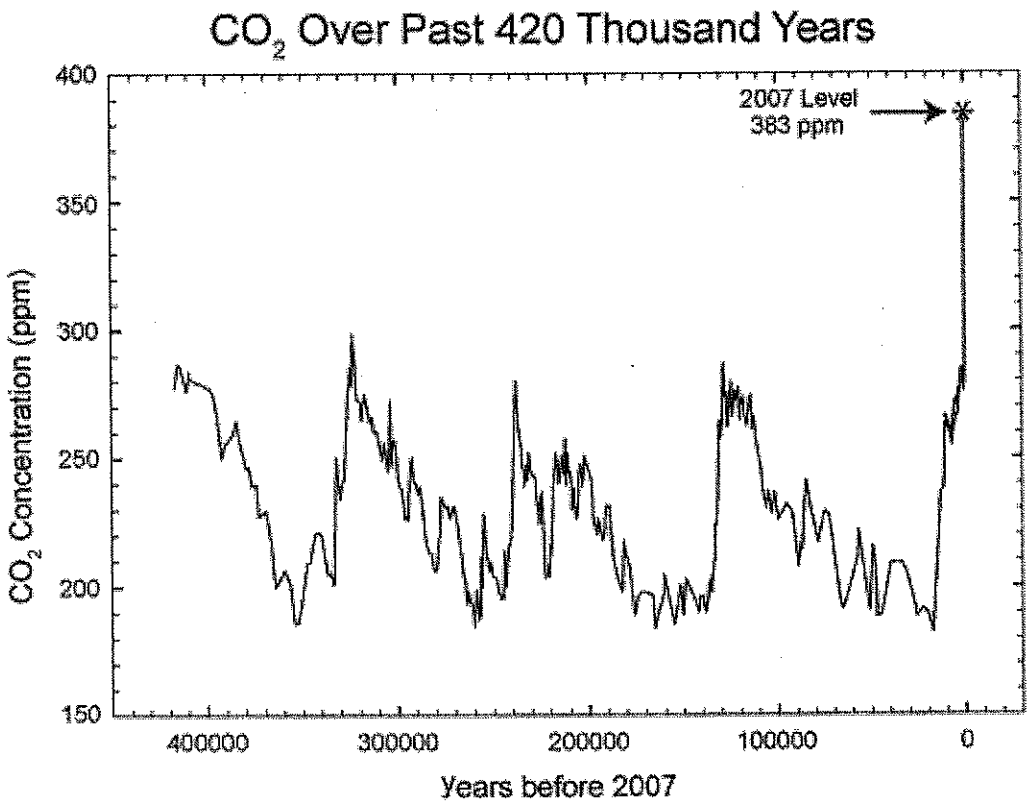
KEELING CURVE LESSONS

The Mauna Loa record can now be placed in the context of the variations in CO_2 over the past 400,000 years, based on reconstructions from polar ice cores. During ice ages, the CO_2 levels were around 200 ppm, and during the warmer interglacial periods, the levels were around 280 ppm. The levels in 2005 were around 378 ppm.



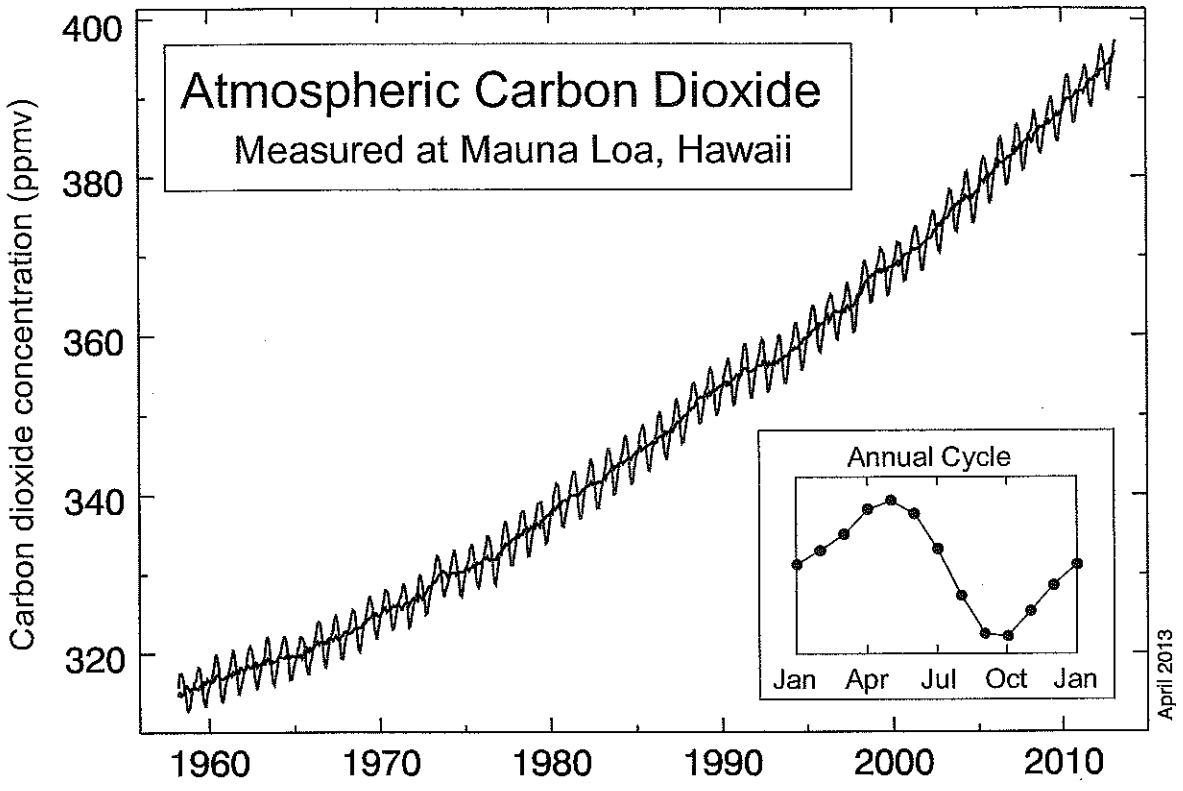
Looking ahead, if the rate of fossil-fuel burning continues to rise on a business-as-usual trajectory, such that humanity exhausts the reserves over the next few centuries, CO_2 will continue to rise to levels of order 1500 ppm. The atmosphere will not return to pre-industrial levels even tens of thousands of years into the future. Unless serious efforts are made to reduce the dependence on fossil fuels, it is clear that we are on a threshold of a new era of geologic history, one with climate very different from that of our ancestors.

Keeling Curve

The **Keeling Curve** is a graph which plots the ongoing change in concentration of carbon dioxide in Earth's atmosphere since 1958. It is based on continuous measurements taken at the Mauna Loa Observatory in Hawaii under the supervision of Charles David Keeling. Keeling's measurements showed the first significant evidence of rapidly increasing carbon dioxide levels in the atmosphere. Many scientists credit Keeling's graph with first bringing the world's attention to the current increase of carbon dioxide in the atmosphere.[1]

Charles David Keeling, of the Scripps Institution of Oceanography at UC San Diego, was the first person to make frequent regular measurements of the atmospheric carbon dioxide (CO_2) concentration, taking readings at the South Pole and in Hawaii from 1958 onwards.[2]

Prior to Keeling, the concentration of carbon dioxide in the atmosphere was thought to be affected by constant variability. Keeling had perfected the measurement techniques and observed "strong diurnal behavior with steady values of about 310 ppm in the afternoon" at three locations: (Big Sur near Monterey, the rain forests of Olympic Peninsula and high mountain forests in Arizona).[3] By measuring the ratio of two isotopes of carbon, Keeling attributed the diurnal change to respiration from local plants and soils, with afternoon values representative of the "free atmosphere". By 1960, Keeling and his group had determined that the measurement records from California, Antarctica, and Hawaii were long enough to see not just the diurnal and seasonal variations, but also a year-on-year increase that roughly matched the amount of fossil fuels burned per year. In the article that made him famous, Keeling observed, "at the South Pole the observed rate of increase is nearly that to be expected from the combustion of fossil fuel". He also noted an apparent absence of any reduction due to absorption of CO_2 by the oceans.[4]



One suspected geological symptom resulting from human activity is increasing atmospheric carbon dioxide (CO_2) content. During the glacial–interglacial cycles of the past million years, natural processes have varied CO_2 by approximately 100 ppm (from 180 ppm to 280 ppm). As of 2011, anthropogenic net emissions of CO_2 have increased its atmospheric concentration by a comparable amount from 280 ppm (Holocene or pre-industrial "equilibrium") to approximately 390 ppm.[17] This signal in the Earth's climate system is especially significant because it is occurring much faster,[18] and to an enormously greater extent, than previous, similar changes. Most of this increase is due to the combustion of fossil fuels such as coal, oil, and gas, although smaller fractions are the result of cement production and land-use changes (e.g. deforestation).

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