Climate change

The latest figures on the global carbon budget indicate a four-fold increase in growth rate of human-generated carbon dioxide emissions since 2000, according to the Global Carbon Project (GCP).

The GCP is hosted by CSIRO and is part of an international climate research group generating an annual report that is now considered a primary reference on the human effects on atmospheric CO_2 for governments and policy-makers around the world.

The findings also indicate that natural carbon sinks, which play an important role in buffering the impact of rising emissions from human activity, have not been able to keep pace with rising CO_2 levels. On average only 45% of each year's emissions remain in the atmosphere. The remaining 55% is absorbed by land and ocean sinks.

In their breakdown, the researchers determined that human activities have released 500 Pg of carbon (1 Pg = 1 petagram = 1 billion tonnes = 10^{15} grams) to the atmosphere in the form of CO_2 since the beginning of the Industrial Revolution around 1750. These emissions have led to an increase of 38% in atmospheric CO_2, from 280 ppm in 1750 to 387 ppm in 2009, and contributed 63% of all anthropogenic radiative forcing to date. Currently, CO_2 emissions are responsible for 80% of the growth of anthropogenic radiative forcing.

The total CO_2 emission flux from human activities was almost 10 Pg carbon per year (Pg C/year) in 2008, made up of 8.7 Pg C/year from fossil fuel combustion and industrial activities, and the rest from net land use change (LUC).

The dominant CO_2 emissions contribution from fossil fuels has accelerated in recent years, increasing at an average growth rate of 3.4%/year during the period 2000–2008, compared to 1.1%/year during the 1990s and an average of 2%/year since 1970. This growth rate was above the average of the most carbon-intense IPCC scenarios published in 2000, emphasising the unprecedented and largely unexpected emissions growth of the last decade.

An important aspect of this acceleration has been an increase in the global share of emissions from the combustion of coal for electricity generation in emerging economies, particularly China and India. Coal was the single largest source of fossil fuel emissions in 2007 and 2008, after more than 40 years of oil supremacy.

In 2008, developing countries emitted more fossil-fuel CO_2 (55% of the total) than the developed world (45%); however, per capita emissions remained much higher in developed countries. The global financial crisis that began in 2008 is expected to have a discernable impact on global fossil-fuel CO_2 emissions, but a scarcely detectable effect on the growth of the concentration of atmospheric CO_2 because of the large interannual variability in natural CO_2 sinks. The emission growth in 2008 was 2.0%/year, less than the average of 3.6%/year for 2000–2007, suggesting an incipient slowdown from the global financial crisis. The projection for 2009, based on a contraction of the gross world product by 1.8%, is a decline of 2.8%/year in fossil fuel emissions. This is likely to be followed by a rapid return to emissions growth.

Emissions from LUC, the second most important source of anthropogenic CO_2 after the combustion of fossil fuels, are the net balance of multiple fluxes in and out of terrestrial ecosystems, including those from deforestation, degradation and reforestation. This net flux was 1.5 ± 0.7 Pg C/year during the period 1990–2005. There is an indication that LUC emissions decreased in 2007–2008, but the trend is not yet clear because of large uncertainty in the estimation of LUC emissions. Averaged since the start of the industrial revolution, LUC emissions account for about one-third of total cumulative CO_2 emissions from human activities, but this fraction has decreased progressively, to 12% in 2008. As emissions from fossil fuel continue to grow, the relative importance of LUC emissions will decline further.

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REFERENCE

Le Quéré C., Raupach M.R., Canadell J.G., Marland G. et al. 2009, *Nature Geoscience*, doi: 10.1038/ngeo689.