

23 December 2009 Clean Energy – Analyst Reaction

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Keeping cool on climate science

Executive Summary

The “Climategate” scandal involving emails between scientists at a university in the UK, has coincided with a sudden cold snap in parts of northern Europe and the eastern US. The two events have had an impact on public opinion and the media, causing some questioning – at least temporarily – of the consensus on climate change and global warming. This Analyst Reaction seeks to present the sober evidence on climate, carbon and emissions.

- Global CO₂ levels were 40% higher in 2008 than they were in 1990. Since 1990, the total increase in radiative forcing caused by all long-lived greenhouse gases is 26% and the rise was 1.3% from 2007 to 2008.
- Temperatures have increased by 0.19°C per decade over the past 25 years, in line with the predictions made by climate models and every full year this century (2001-08) so far has been among the top 10 warmest years since instrumental records began.
- Melting of the ice from glaciers, ice caps and the Antarctic and Greenland ice sheets is accelerating and climate models have significantly underestimated the acceleration of the melting of sea-ice in the Arctic during the summer.
- Sea-level rises in the last 15 years have been 80% higher than previous predictions by the Intergovernmental Panel on Climate Change. At the same time, tropical cyclones have become more intense in the past 30 years, while ocean surface temperatures were the warmest ever recorded for each of June, July and August 2009.
- The permafrost zone in North America has shifted northward, while in northern Europe, permafrost has been thawing. However, a recent increase in global methane levels cannot yet be attributed to permafrost degradation.

1. The latest science

1.1. The arguments

Opposition to the international consensus on global warming and the need to cut carbon emissions comes in two main varieties. There are those who argue that the world temperatures are not increasing. In many cases, they maintain that 1998 was the hottest year and that since then, temperatures have been falling. Second, there are those who argue that temperatures may be increasing, but that this is not due to carbon emissions. Carbon dioxide levels may be rising but this could be the result, not the cause, of higher temperatures. Instead, other factors such as sunspots are likely to be responsible for climate change.

Neither viewpoint cut much ice at the Copenhagen conference between 7 and 18 December, when national delegations agreed that “deep cuts in global emissions are required according to science”. So, what does the science say about what has already happened, and how has scientific opinion changed since the publication of the fourth IPCC report in 2007?

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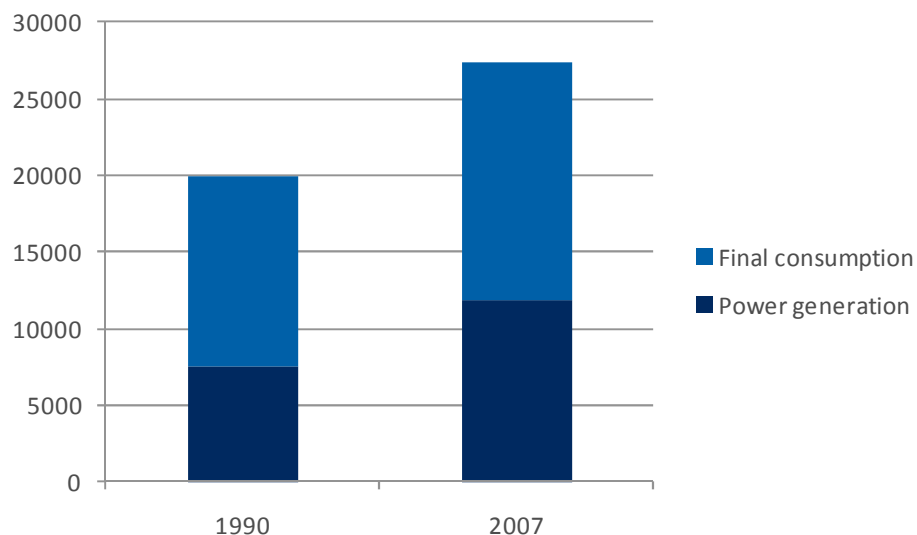
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1.2. Higher emissions

Figures from the International Energy Agency show that CO₂ emissions have been on a sharply rising trend. Figure 1 below shows that total emissions rose by nearly 40% between 1990 and 2007, and although they have been knocked backwards by about 3% in 2009 by the deep recession, but the IEA projects the sharp upward trajectory resuming from 2010.

Figure 1: World CO₂ emissions from power and consumption (million tonnes)



Source: International Energy Agency. Note final consumption includes transport and heating.

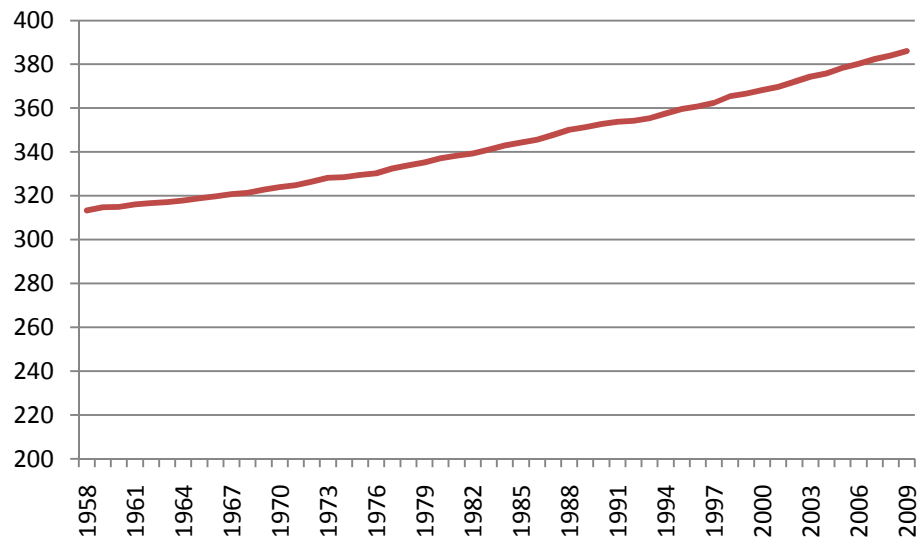
The Climate Change Research Centre (CCRC) at the University of New South Wales in Australia has gathered together the most policy-relevant climate research published since the last IPCC report in a new publication – *The Copenhagen Diagnosis: Updating The World On The Latest Climate Science*.

The most significant recent findings include the fact that emissions of greenhouse gases continue to soar. Global carbon dioxide emissions from fossil fuels in 2008 were nearly 40% higher than those in 1990, according to figures from US Department of Energy Carbon Dioxide Information Center (CDIAC) and BP.

According to the World Meteorological Organisation, CO₂ levels in 2009 were 385.99ppm, compared with 313.33ppm in 1958. “In 2008, global concentrations of carbon dioxide, methane and nitrous oxide, the main long-lived greenhouse gases in the atmosphere, have reached the highest levels recorded since pre-industrial times,” it adds. Since 1990, the total increase in radiative forcing – the amount by which a climatic factor changes temperatures – caused by all long-lived greenhouse gases has been 26% and the rise was 1.3% from 2007 to 2008.

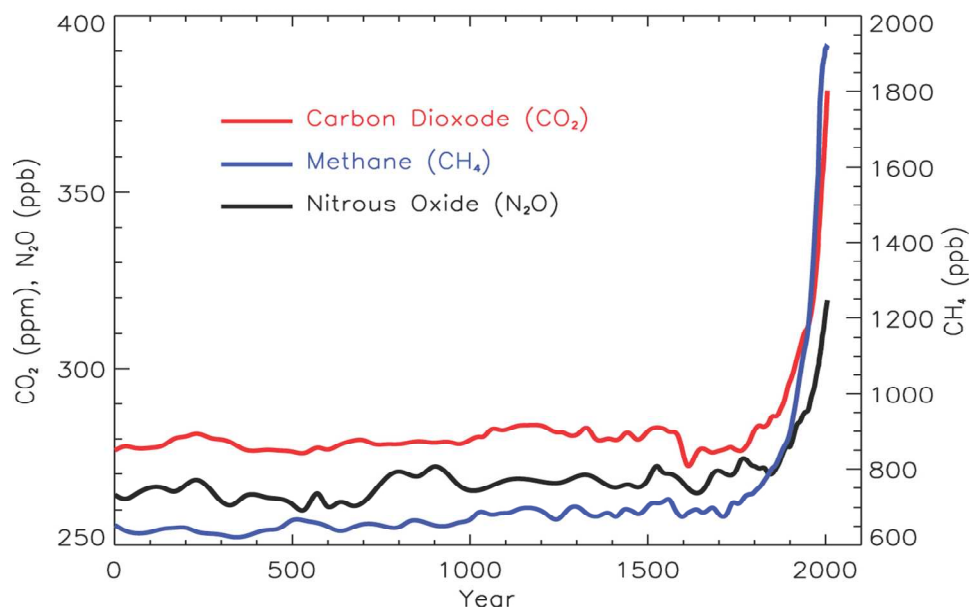
At the same time, global CO₂ emissions from fossil-fuel burning are close to record highs and it appears that the proportion of CO₂ emissions being absorbed by land and ocean reservoirs has fallen by around five percentage points (from 60% to 55%) in the past 50 years, though inter-annual variability is large, according to an article in the Proceedings of the National Academy of Sciences.

Figure 2: CO2 (parts per million), November of each year



Source: Mauna Loa Observatory, Hawaii, National Oceanic & Atmospheric Administration

Figure 3: Concentrations of greenhouse gases from 0 to 2005



Source: IPCC 4th Assessment Report 2007

1.3. Temperatures

Temperatures have increased by 0.19°C per decade over the past 25 years, in line with the predictions made by climate models. “There have been no significant changes in the underlying warming trend,” says the CCRC.

Every year this century (2001-08) has been among the top 10 warmest years since instrumental records began, despite solar irradiance being relatively weak over the past few years. “Increases in hot extremes and decreases in cold extremes have continued and are expected to amplify further,” the report adds.

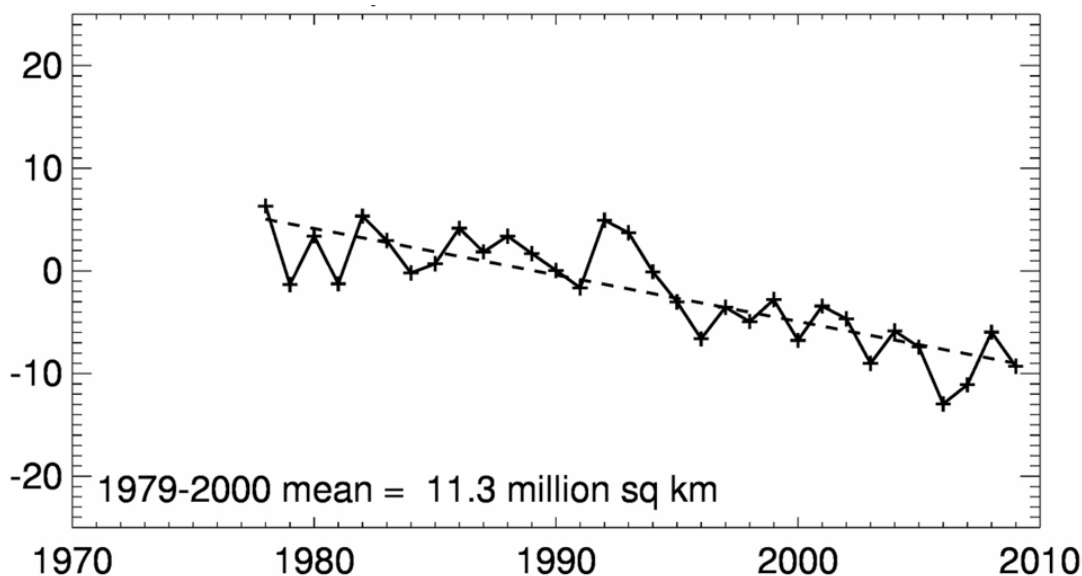
Since 1920, the Earth’s average surface temperature has increased by 1.4 F, with 1F of this change occurring between 1975 and 2005. This is the largest global temperature rise in at least the last 2,000 years and, possibly, the last 5,000 years, according to the US National Academy of Sciences.

1.4. Melting accelerates

New data from satellite and ice measurements show that the melting of the Greenland and Antarctic ice-sheets is accelerating, as is the loss of mass from glaciers and ice-caps in other parts of the world. At the same time, climate models have significantly underestimated the acceleration of the melting of sea-ice in the Arctic during the summer. "The area of sea-ice melt during 2007-09 was about 40% greater than the average prediction from IPCC AR4 climate models," says the CCRC report.

Another area of under-estimation has been on sea-level rises, where satellite data reveal that the average sea-level of 3.4mm/yr over the last 15 years – 80% higher than previous IPCC predictions. This acceleration is consistent with "a doubling in contribution from melting of glaciers, ice caps, and the Greenland and West-Antarctic ice-sheets," the report adds.

Figure 3: Changes in the extent of Arctic Sea Ice 1970-2009 (anomalies, %)



Source: NASA National Snow and Ice Data Center

At the same time, new analysis confirms that tropical cyclones have become more intense in the past 30 years, in line with the increase in the temperature of tropical oceans, according to research published in *Nature* in 2009. Global ocean surface temperature reached the warmest ever recorded in each of June, July and August 2009.

Back on land, the permafrost zone in North America has shifted northward, while in northern Europe, permafrost has been thawing. However, a recent increase in global methane levels cannot yet be attributed to permafrost degradation, the CCRC report says.

2. The CRU controversy

The publication of emails stolen from the Climatic Research Unit at the University of East Anglia has excited a great deal of controversy. Some of the emails disparaged climate sceptics but the most notorious one, from CRU director Phil Jones, said: "I've just completed Mike's Nature trick of adding in the real temps to each series for the last 20 years (ie from 1981 onwards) and from 1961 for Keith's to hide the decline." Sceptics say this proves scientists have been manipulating data to show climate change to be worse than it is.

However, the website Skeptical Science points out: "Mike's Nature trick refers to the paper Global-scale temperature patterns and climate forcing over the past six centuries (Mann 1998), published in *Nature* by lead author Michael Mann. The "trick" is the technique of plotting recent instrumental data along with the reconstructed data [which is derived from tree rings]. This places recent global warming trends in the context of temperature changes over longer time scales." Indications of temperature from tree rings from 1960 onwards diverges with instrumental records, and so tree ring researchers have always recommended not using their data from 1960 onwards, which is what the Mann article explains. Others point out that there is no "smoking gun" – no evidence of any worldwide conspiracy, no admission that global warming is a hoax, no evidence of the falsifying of data.

According to Professor Julia Slingo, chief scientist of the UK's Met Office, the CRU's data is just one of three records of global temperature going back over the last century or more. The others are maintained by the US's National Oceanic and Atmospheric Administration (NOAA) and NASA's Goddard Institute for Space Studies. "The three independent records are entirely consistent that our temperatures have been rising rapidly," she says. "Global mean temperatures are only one measure of global warming and we have many other variables that we can draw on and show. Sea-level rise is one, retreating glaciers is another, shifts in rainfall patterns that we are beginning to see — all consistent, and support the science of climate change."

The Met Office plans to release all its data, she added, "and it will be shown that this record is robust and the global warming signal is irrefutable".

The CRU has been shown to underestimate the rise in global average temperatures over the past 30 years when compared against a fuller analysis of global temperatures using separate, non-land-based sources, the Met Office adds.

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