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Methane's impact on global warming far higher than previously thought

Mark Henderson, Science Editor

The effects of a critical greenhouse gas on global warming have been significantly underestimated, according to research suggesting that emissions controls and climate models may need to be revised

Methane's impact on global temperatures is about a third higher than generally thought because previous estimates have not accounted for its interaction with airborne particles called aerosols, Nasa scientists found.

When this indirect effect of the potent greenhouse gas is included one tonne of methane has about 33 times as much effect on the climate over 100 years as a tonne of carbon dioxide, rather than 25 times as in standard estimates.

Drew Shindell, of the Nasa Goddard Institute for Space Studies in New York, who led the study, said that the findings added to the importance of measures to contain methane emissions, as well as those of carbon dioxide, which will be discussed at the Copenhagen climate summit in December.

As methane breaks down much more quickly than carbon dioxide, the impact of cuts on climate would also be faster. "For long-term climate change there's no way around dealing with CO2 — it's the biggest thing and it lasts hundreds of years," Dr Shindell told *The Times*. "But if we were to have a concerted effort to deal with non-CO2 we could have a very large impact on the near term.

"Substantial reductions in methane, carbon monoxide and black carbon: that's the way to make a big difference. I think it should be more of a priority [for Copenhagen]."

Dr Shindell's results, published in the journal Science, also raise the possibility that global warming forecasts may be too optimistic. The most recent report from the Intergovernmental Panel on Climate Change, published in 2007, predicts that global temperatures will rise by between 1.1C and 6.4C during the 21st century.

The study has further implications for emissions trading schemes, which currently focus only on carbon dioxide. For these to be effective the warming effects of methane need to be pegged to those of carbon dioxide at the right "exchange rate".

Dr Shindell said: "We undervalue methane. The whole point of having a scale is to relate different gases together, to enlarge the pool of mitigation options. But if you've got the wrong value for one, clearly you don't have maximum efficiency."

The researchers wrote in Science: "We found that gas-aerosol interactions substantially alter the relative importance of the various emissions. In particular, methane emissions have a larger impact than that used in current carbon-trading schemes or in the Kyoto Protocol."

The exchange rate between carbon dioxide and other greenhouse gases is generally calculated according to global warming potential (GWP), which measures the effects of one tonne of a gas on warming over 100 years in comparison to one tonne of carbon dioxide.

Keith Shine, of the University of Reading, one of the originators of the GWP concept, said that Dr Shindell's work would help to refine this. "It does change the picture quite significantly," he said. "GWP is an exchange rate between different gases and this does potentially change the rate to make methane more valuable, giving more encouragement to reduce methane emissions."

He said, however, that emissions controls should continue to focus chiefly on carbon dioxide. "The long-term effects of carbon dioxide are so strong that if you take the eye off the ball you will be storing up problems for the future."

Methane is acknowledged as the second most important greenhouse gas produced by human activity after carbon dioxide and is responsible for about a fifth of warming effects. Its chief sources are landfill sites, fossil fuel energy and agriculture, particularly rice and livestock farming.

In the study Dr Shindell used computer models to investigate how methane, carbon monoxide and other greenhouse gases besides CO2 interacted with aerosols — airborne particles such as sulphate molecules.

Sulphate molecules, produced when sulphur dioxide is oxidised in the atmosphere, have a cooling effect on the climate as they reflect heat but, while their direct effects are included in climate models, their indirect effects in combination with methane and other gases are not.

Methane and carbon monoxide reduce levels of sulphate aerosols, because they use up oxidants such as hydroxyl in the atmosphere. Fewer oxidant molecules are thus available to oxidise sulphur dioxide to produce sulphate.

“What happens is that as you put more methane into the atmosphere, it competes for oxidants such as hydroxyl with sulphur dioxide,” Dr Shindell said. “More methane means less sulphate, which is reflective and thus has a cooling effect. Calculations of GWP including these gas-aerosol linkages thus substantially increase the value for methane.”

Chris Huntingford, of the Centre for Ecology & Hydrology, said: “This is an excellent analysis demonstrating that methane emissions have the potential to add more to future warming than hereto realised. This new research complements the well-established result that carbon dioxide emissions have been responsible for a large fraction of the global warming observed since pre-industrial times.

“There is a requirement to distil this more complete understanding of how the many different atmospheric gases interact, both between themselves and with humans. Policy decisions must account for such interactions and links to emissions of carbon dioxide, methane, and atmospheric aerosols.”