Scientific controversy in detecting decline in carbon sink efficiency

According to research published this week in *Nature Geoscience*, emissions of carbon dioxide continue to outstrip the ability of the world's natural 'sinks' to absorb carbon.

The *Nature Geoscience* authors report a 29 per cent increase in global CO2 emissions from fossil fuel between 2000 and 2008 (the latest year for which figures are available), and that emissions still increased by 2 per cent during 2008, in spite of the global economic downturn.

Bristol University researchers Pru Foster, Pierre Friedlingstein, Jo House and Colin Prentice, together with a word-wide team of researchers from the Global Carbon Project, found that the rising emissions are largely attributed to increasing contributions from emerging economies such as India and China, with some of the growth in emissions attributed to exports to Europe and America.

About 60% of the carbon dioxide we emit to the atmosphere is taken up by natural sinks on land and in the ocean. An important issue for policymakers in Copenhagen next month will be whether the efficiency of these natural sinks to absorb emissions is declining or not.

The *Nature Geoscience* authors, found that over the past 50 years the average fraction of global CO2 emissions that remained in the atmosphere each year has likely increased from 40 per cent to 45 per cent, suggesting a decrease in the efficiency of the natural ocean and land sinks. The team brings evidence that the sinks are already responding to climate change and variability.

The new report follows another study published only ten days earlier by Dr Wolfgang Knorr, also from the University of Bristol's QUEST programme, in *Geophysical Research Letters*, which concluded that a decline in the capacity of

the land and ocean to absorb CO_2 cannot yet be detected within the available data. Dr Wolfgang Knorr's study addressed a range of analytical methods, among them the broad method used by the Global Carbon Project. He found that in fact the trend in the airborne fraction during the past 50 years has been negative at -0.2 ± 1.7% per decade, which is essentially zero. He therefore concluded that the capacity of terrestrial ecosystems and the oceans to absorb CO_2 has not yet diminished.

Scientists involved in both studies agree that the CO2 sink capacity will decline under unmitigated climate change, meaning more of the CO2 that is emitted will stay in the atmosphere. The key controversy here is whether we can already detect such a decline.

Both studies are based on atmospheric composition data and statistical data on energy use and land use change, but differ in the way they calculate the trend, how they treat uncertainties in atmospheric concentrations, and how they account for confounding variability in atmospheric CO2 (eg. from year to year climate variability due to El Nino events or from volcanic eruptions).

Dr Jo House of Bristol University and an author on the *Nature Geoscience* paper says, "It is difficult to accurately estimate sources and sinks of CO2, particularly in emissions from land use change where data on the area and nature of deforestation is poor. While the science has advanced rapidly, there are still gaps in our knowledge."

Wolfgang Knorr added: "We are just at the very edge of being able to detect a trend in the airborne fraction, which is predicted to increase from 45% now to between 55 and 70% by the end of the century according to future projections from climate-carbon cycle models. Our apparently conflicting results demonstrate what doing real science is like and just how difficult it is to accurately quantify such data. Nevertheless, the team of QUEST researchers at the University of Bristol are working closely together, and with other researchers in the field, to provide the most cutting edge and up-to-date results possible."

Despite the knowledge gaps, all authors are in agreement that the only way to control climate change is through a drastic reduction in global CO_2 emissions. ENDS