

Carbon cycling was much smaller during last ice age than in today's climate: study

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Atmospheric carbon dioxide (CO₂) is one of the most important greenhouse gases and the increase of its abundance in the atmosphere by fossil fuel burning is the main cause of future global warming. In past times, during the transition between an ice age and a warm period, atmospheric CO₂ concentrations changed by some 100 parts per million (ppm) – from an ice age value of 180 ppm to about 280 ppm during warm periods.

Scientists can reconstruct these changes in the atmospheric carbon stock using direct measurements of atmospheric CO₂ trapped in air bubbles in the depth of Antarctica's ice sheets. However explaining the cause of these 100ppm changes in atmospheric CO₂ concentrations between

glacial and interglacial climate states – as well as estimating the carbon stored on land and in the ocean – is far more difficult.

The researchers, led by Dr Philippe Ciais of the Laboratoire des Sciences du Climat et l'Environnement near Paris, ingeniously combined measurements of isotopes of atmospheric oxygen (^{18}O) and carbon (^{13}C) in marine sediments and ice cores with results from dynamic global vegetation models, the latter being driven by estimates of glacial climate using climate models.

Dr Marko Scholze of the University of Bristol's School of Earth Sciences, co-author on the paper said: "The difference between glacial and pre-industrial carbon stored in the terrestrial biosphere is only about 330 petagrams of carbon, which is much smaller than previously thought. The uptake of carbon by vegetation and soil, that is the terrestrial productivity during the ice age, was only about 40 petagrams of carbon per year and thus much smaller: roughly one third of present-day terrestrial productivity and roughly half of pre-industrial productivity."

From these results, the authors conclude that the cycling of carbon in the terrestrial biosphere – that is, the time between uptake by photosynthesis and release by decomposition of dead plant material – must have been much smaller than in the current, warmer climate.

Furthermore there must have been a much larger size of non-decomposable carbon on land during the Last Glacial Maximum (the period in the Earth's history when ice sheets were at their maximum extension, between 26,500 and 19,000 years ago).

The authors suggest that this inert carbon should have been buried in the permanently frozen soils and large amounts of peat of the northern tundra regions.

More information: 'Large inert carbon pool in the terrestrial biosphere during the Last Glacial Maximum' by P. Ciais, A. Tagliabue, M. Cuntz, L. Bopp, M. Scholze, G. Hoffmann, A. Lourantou, S. P. Harrison, I. C. Prentice, D. I. Kelley, C. Koven and S. L. Piao, *Nature Geoscience*, 2011.

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