Research reveals how global warming will impact Earth's carbon cycle

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A research review by University of Exeter climate scientist, Professor Pierre Friedlingstein, examines how state-of-the-art mathematical modelling can help clarify carbon cycle sensitivity to climate change.

Although the link between climate change, the land and ocean carbon

cycle and the increase of carbon dioxide in the atmosphere is well documented, there was uncertainty surrounding how quickly it occurred.

However, pioneering new techniques have helped to reduce this uncertainty, over both short and long timescales, to give a more accurate representation of how quickly the process occurs.

Crucially, the research shows that the carbon cycle sensitivity to climate change is at the lower end of previous predictions, meaning that it may not occur as quickly as had been thought.

The review article, titled "Carbon cycle feedbacks and future climate change," appears in the latest volume of the Royal Society's *Philosophical Transactions A* journal.

Professor Friedlingstein, who is the Chair of Exeter's Mathematical Modelling of Climate Systems research group, said: "Combining data over long millennium and short inter-annual time scales reveals that the climate-carbon cycle feedback is at the low end of Earth System Models projections. Warming will lead to more CO2 in the atmosphere, but not as much as predicted by most models, which is good news."

Professor Friedlingstein's review paper shows that use of observational constraints can help reducing uncertainties and make more policy relevant climate change projections.

For short timescales, observations of atmospheric CO2 growth rate show that the years in which the El Niño weather phenomenon occur record larger than average atmospheric CO2 growth rate, with tropical land ecosystems being the main drivers. Such atmospheric CO2 excursions, driven by climate variability, are key to constraint Earth System Models sensitivity.

For longer term timescales, temperature and atmospheric CO2 variability as recorded over the last millennium can also be used to restrict how rapidly the global carbon cycle responds to climate change.

Professor Friedlingstein added: "It is extremely reassuring to see that these completely independent approaches, using very rapid or very slow changes in the climate forcing, lead to a very similar conclusion when it comes to the sensitivity of the global carbon cycle to climate."

More information: Pierre Friedlingstein. Carbon cycle feedbacks and future climate change, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* (2015). DOI: 10.1098/rsta.2014.0421

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