Unaccounted feedbacks from climate-induced ecosystem changes may increase future climate warming

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In addition to the carbon cycle-climate interactions that have been a major focus of modeling work in recent years, other biogeochemistry feedbacks could be at least equally important for future climate change. The authors of the *Nature Geoscience* article argue that it is important to include these feedbacks in the next generation of Earth system models.

The terrestrial biosphere regulates atmospheric composition, and hence climate. Projections of future climate changes already account for "carbon-climate feedbacks", which means that more CO_2 is released from soils in a warming climate than is taken up by plants due to photosynthesis. Climate changes will also lead to increases in the emission of CO_2 and methane from wetlands, nitrous oxides from soils, volatile organic compounds from forests, and trace gases and soot from fires. All these emissions affect atmospheric chemistry, including the amount of ozone in the lower atmosphere, where it acts as a powerful greenhouse gas as well as a pollutant toxic to people and plants.

Although our understanding of other feedbacks associated with climate-induced ecosystem changes is improving, the impact of these changes is not yet accounted for in climate-change modelling. An international consortium of scientists, led by Almut Arneth from Lund University, has estimated the importance of these unaccounted "biogeochemical feedbacks" in an article that appears as Advance Online Publication on *Nature Geoscience*'s website on 25 July at 1800 London time. They estimate a total additional radiative forcing by the end of the 21st century that is large enough to offset a significant proportion of the cooling due to carbon uptake by the biosphere as a result of fertilization of plant growth.

There are large uncertainties associated in these feedbacks, especially in how changes in one biogeochemical cycle will affect the other cycles, for example how changes in nitrogen cycling will affect carbon uptake. Nevertheless, as the authors point out, palaeo-environmental records show that ecosystems and trace gas emissions have responded to past climate change within decades. Contemporary observations also show that ecosystem processes respond rapidly to changes in climate and the atmospheric environment.

Thus, in addition to the carbon cycle-climate interactions that have been a major focus of modelling work in recent years, other biogeochemistry feedbacks could be at least equally important for future climate change. The authors of the Nature Geoscience article argue that it is important to include these feedbacks in the next generation of Earth system models.

Provided by University of Helsinki

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