Geophysical Research Abstracts
Vol. 19, EGU2017-7717, 2017
EGU General Assembly 2017

The committed long-term sink of carbon due to vegetation changes may rival carbon losses due to permafrost thawing

Thomas Pugh (1,2), Chris Jones (3), Chantelle Burton (3), Chris Huntingford (4), Almut Arneth (2), Mark Lomas (5), Shilong Piao (6), and Stephen Sitch (7)

(1) School of Geography, Earth and Environmental Sciences and Birmingham Institute of Forest Research, University of Birmingham, Birmingham, B15 2TT, United Kingdom. (t.a.m.pugh@bham.ac.uk), (2) Karlsruhe Institute of Technology, Institute of Atmospheric Environmental Research (IMK-IFU), Kreuzeckbahnstrasse 19, 82467, Garmisch-Partenkirchen, Germany., (3) Met Office Hadley Centre, FitzRoy Road, Exeter EX1 3PB, UK., (4) Centre for Ecology and Hydrology,Wallingford OX10 8BB, UK., (5) University of Sheffield, Centre for Terrestrial Carbon Dynamics, Sheffield, United Kingdom., (6) Department of Ecology, College of Urban and Environmental Sciences, Peking University, 5 Yiheyuan Road, Haidian District, Beijing 100871, China., (7) Geography, College of Life and Environmental Sciences, Amory Building, University of Exeter, Exeter EX4 4RJ, UK.

The terrestrial biosphere provides an important sink of atmospheric carbon, the size and persistence of which is one of the largest uncertainties in future climate projections. However, the response of the biosphere to changes in its environment substantially lags the rate of environmental change in many aspects. Transient assessments of changes in ecosystem properties therefore do not capture the full magnitude of the response to which ecosystems are committed. Here an ensemble of Dynamic Global Vegetation Model and Earth System Model simulations is used to assess the magnitude of committed changes in tree cover and carbon storage, to attribute the drivers of uncertainty in these values, and to assess the likely magnitude and direction of committed changes in biospheric carbon stocks post 2100. The results show consistently large committed changes post-2100 in slow components of ecosystems, notably carbon stores and vegetation cover fractions, despite relatively small changes in productivity. In boreal locations, increases in vegetation and soil carbon storage may be large enough to offset committed carbon losses from thawing permafrost. As much of this committed sink results from increased biomass as a result of changes in vegetation composition, the results indicate a pressing need for vegetation dynamics, as well as the now widely-considered anthropogenic land cover change, to be more routinely represented in the coupled Earth System Models used to make future climate projections. However, the timescales over which committed changes in vegetation cover and biomass occur are highly uncertain, and represent a key limitation in assessing whether the simulated committed sink will be realised on human-relevant timescales. A move away from evaluating DGVMs in terms of their stable vegetation state, towards addressing their ability to capture transient responses, is advocated.