Geophysical Research Abstracts
Vol. 15, EGU2013-6071, 2013
EGU General Assembly 2013

Reversal of the land biosphere carbon balance under climate and land-use change

Christoph Müller (1), Elke Stehfest (2), Jelle van Minnen (2), Bart Strengers (2), Werner von Bloh (1), Arthur Beusen (2), Sibyll Schaphoff (1), Tom Kram (2), and Wolfgang Lucht (1)

(1) Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany (cmueller@pik-potsdam.de), (2) Netherlands Environmental Assessment Agency (PBL), Bilthoven, The Netherlands

In the past three decades, the land biosphere has reduced anthropogenic climate change by sequestering about 2Pg yr-1 of carbon annually that would have increased atmospheric carbon dioxide (CO_2) concentrations otherwise. In order to define future reduction targets of CO_2 it is important to understand this balance. Global warming and land-use change have the potential to substantially alter the land biosphere's capacity to sequester carbon, possibly establishing a positive feedback if turning it into a net source of CO_2. This study investigates the land biosphere C balance of the 21st century under multiple climate and land-use assumptions using the coupled IMAGE-LPJmL model. This coupling allows for direct accounting for the direct feedbacks between land-use change, climate change and the land biosphere carbon balance. We find that a possible sink-source shift is mainly determined by two large uncertainties in climate change projections: the spatial pattern of climate change and the climate sensitivity. Systematically varying climate sensitivity and GCM-specific patterns of climate change, we show that if the climate sensitivity is less than 2.5oC, the biosphere will likely remain a net carbon sink throughout the 21st century, although even in this situation there are numerous climate/land use combinations that show a considerable decrease in the current sink. At a climate sensitivity of 4.5oC or more, the land biosphere very likely turns into a net carbon source between 2040 and 2080, where the net biospheric emissions could increase to up to 10 PgCyr-1. We analyze to what extent various properties of the earth system (size of carbon stocks, GMT, population, extent of agricultural land, atmospheric CO_2 concentrations, climate change in carbon-rich regions) are related to the carbon-balance reversal. First results indicate that a global mean temperature increase of 0.04 °Cyr-1 often is related to the reversal of the land biosphere carbon balance or at least to declining trends in the carbon sequestration rate.