Geophysical Research Abstracts
Vol. 19, EGU2017-13881, 2017
EGU General Assembly 2017

A novel assessment of the role of land-use and land-cover change in the global carbon cycle, using a new Dynamic Global Vegetation Model version of the CABLE land surface model

Vanessa Haverd (1), Benjamin Smith (2,1), Lars Nieradzik (3,1), Peter Briggs (1), and Josep Canadell (1)

(1) CSIRO Oceans and Atmosphere, GPO Box 3023, Canberra ACT 2601, Australia (vanessa.haverd@csiro.au), (2) Lund University, Department of Physical Geography and Ecosystem Science, 22362 Lund, Sweden, (3) Centre for Environmental and Climate Research Lund University, 223 62 Lund, Sweden

In recent decades, terrestrial ecosystems have sequestered around 1.2 PgC y-1, an amount equivalent to 20% of fossil-fuel emissions. This land carbon flux is the net result of the impact of changing climate and CO_2 on ecosystem productivity (CO_2-climate driven land sink) and deforestation, harvest and secondary forest regrowth (the land-use change (LUC) flux). The future trajectory of the land carbon flux is highly dependent upon the contributions of these processes to the net flux. However their contributions are highly uncertain, in part because the CO_2-climate driven land sink and LUC components are often estimated independently, when in fact they are coupled.

We provide a novel assessment of global land carbon fluxes (1800-2015) that integrates land-use effects with the effects of changing climate and CO_2 on ecosystem productivity. For this, we use a new land-use enabled Dynamic Global Vegetation Model (DGVM) version of the CABLE land surface model, suitable for use in attributing changes in terrestrial carbon balance, and in predicting changes in vegetation cover and associated effects on land-atmosphere exchange. In this model, land-use-change is driven by prescribed gross land-use transitions and harvest areas, which are converted to changes in land-use area and transfer of carbon between pools (soil, litter, biomass, harvested wood products and cleared wood pools).

A novel aspect is the treatment of secondary woody vegetation via the coupling between the land-use module and the POP (Populations Order Physiology) module for woody demography and disturbance-mediated landscape heterogeneity. Land-use transitions to and from secondary forest tiles modify the patch age distribution within secondary-vegetated tiles, in turn affecting biomass accumulation and turnover rates and hence the magnitude of the secondary forest sink. The resulting secondary forest patch age distribution also influences the magnitude of the secondary forest harvest and clearance fluxes, with oldest patches (high biomass) being preferentially harvested, and youngest patches (low biomass) being preferentially cleared.

Our results, which agree well with the net land flux derived from the global carbon budget, are used for a process-attribution of the land carbon sink. Use of multiple constraints provides confidence in our process-attribution: we use observation-based data sets to evaluate predictions of global spatial distributions of vegetation cover, evaporation, gross primary production, biomass and soil carbon; interannual variability of the global terrestrial carbon sink; forest allometric relations and age-effects on net primary production.