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Effects on carbon cycle and vegetation dynamics from woodfuel extraction using a dynamic global vegetation model (LPJmL)

M. Gumpenberger

Potsdam Institute for Climate Impact Research, Climate Impacts and Vulnerabilities, Potsdam, Germany (marlies.gumpenberger@pik-potsdam.de / Phone: +49-331-288-2415)

Wood energy is gradually penetrating the new energy markets of industrialized countries as a clean and locally available source of energy. Meanwhile, in developing countries wood-based fuels remain the dominant source of energy for over 2 billion people. In global terms, woodfuels represent about 7 percent of the world's total primary energy consumption (FAO, 2002). In many developing countries unused residues from forests and forest industries represent a large untapped wood energy potential. Overexploitation of forests, however, has to be avoided in order to sustain environmental resources and livelihoods. A global vegetation model was used to analyse i) the supply and demand relationship of woodfuel consumption ii) the consequences on carbon cycle (emissions) and iii) changes in vegetation patterns. The LPJmL model (Bondeau *et al*., 2007) is based on the LPJ-DGVM (Sitch *et al*., 2003), a biogeochemical process model that simulates global terrestrial vegetation and soil dynamics and the associated carbon and water cycles. LPJmL (LPJ managed Land) simulates the effects of land-use (e.g. crop growth and harvest) and land-use change (e.g. deforestation) on the terrestrial carbon cycle. Population density from HYDE 3.0 (Goldewijk *et al*., 2006) and regional per capita consumption data (FAO; Yevich & Logan, 2003) were used as inputs for LPJmL to get the demand on woodfuel. According to demand and supply, woodfuel is extracted from the ("dead" wood) of vegetation litter and from biomass of living trees. The woodfuel is assumed to be burned within one year and the carbon content is respired to the atmosphere. Although, trading of woodfuels is an important issue, it could not be considered in the model. Preliminary results showed

that global woodfuel consumption, which is between 280 and 820 TgC y^{-1} during the last century, increased global grass biomass by 8.3%, while global tree cover, soil carbon stock and litter carbon decreased by 0.4%, 0.4%, and 1.4%, respectively. The changes in vegetation carbon stocks in the simulation period (1901-2003) correspond to a net carbon loss of 9.3 PgC. The increase of grass biomass was found particularly in subarid zones of China, India, and Africa (Sahel). A spatially explicit demand/supply analysis showed that LPJmL simulates scarcity of woodfuel in Sahelian countries, the Nile Delta, Somalia, Pakistan, India (in particular NE), Bangladesh, subarid regions in China and parts of the Andean highlands. Vegetation dynamics and carbon fluxes are evaluated for selected regions (e.g. Sahel).