Geophysical Research Abstracts
Vol. 21, EGU2019-11583-1, 2019
EGU General Assembly 2019

Simulating soil C dynamics during land use change transitions from tropical forest to oil palm plantations

Rahmi Ariani (1), Alexander Knohl (1), Yuanchao Fan (2), Tanja June (3), and Fernando Moyano (1)

(1) University of Göttingen, Bioclimatology, Göttingen, Germany (fmoyano@uni-goettingen.de), (2) Uni Research Climate, Bjerknes Centre for Climate Research, Bergen, Norway, (3) Bogor Agricultural University, Geophysics and Meteorology, Dramaga, Bogor, Indonesia

Changes in land-use and climate can contribute to important CO_2 emissions from soil to the atmosphere. In such scenarios, models are necessary to predict future changes, to extrapolate results to larger areas as well as to explore and understand underlying mechanisms. Many drivers of ecosystem dynamics play a role in tropical regions, including deforestation, land use intensification, increasing concentrations of atmospheric CO_2 and possible changes in temperature and precipitation. Our study aims to simulate changes in soil C associated with transitions from the natural forest vegetation to oil palm plantations as observed in the Jambi region of Sumatra, Indonesia. For this we modeled the vegetation and soil C using the Community Land Model (CLM 4.5) and changed the model parameter values to better fit the model to the observations.

Two aspects were necessary to obtain realistic model outcomes: properly simulating the state of the natural forest vegetation and capturing the dynamics after land use change. Parameter adjustments were made in order to approximate simulations to observed forest productivity, biomass, soil respiration and soil C stocks. Forest disturbance through selective logging also was a factor that needed to be accounted for. Oil palm growth was simulated using a PFT recently developed and calibrated for the same site. Finally, the simulation of soil carbon stocks and soil respiration was improved by adjusting model parameters controlling the turnover time of soil C pools. When using the default parameter values, the model underestimated total soil organic carbon and overestimated soil respiration of both forest and oil palm. The simulated forest carbon stocks increased after model calibration, showing a better agreement with observations (from an average of 6.3 kg C m-2 to 23 kg C m-2; compared to the observed value of 24 kg C m-2). Simulated soil respiration decreased, also approaching observed values and lowering the model RMSE from 20.2 to 16.3 mg C m-2 hour-1. For oil palm, model calibration improved the simulation of soil C stocks (from 5.5 kg C m-2 to 13 kg C m-2, observed value18 kg C m-2) as well as soil respiration (RMSE lowered from 12.5 to 11 mg C m-2 hour-1).

Once the model is fully calibrated, we will be able to estimate the long term effects of land use change and compare them to those of CO_2 fertilization. We will also be able to estimate the regional short and long term impact of land use on soil C stocks and fluxes.