AGU FALL MEETING
San Francisco | 14 – 18 December 2015

B41E-0475: A specific PFT and sub-canopy structure for simulating oil palm in the Community Land Model

Thursday, 17 December 2015
08:00 - 12:20
Moscone South - Poster Hall

Towards an effort to quantify the effects of rainforests to oil palm conversion on land-atmosphere carbon, water and energy fluxes, a specific plant functional type (PFT) and sub-canopy structure are developed for simulating oil palm within the Community Land Model (CLM4.5). Current global land surface models only simulate annual crops beside natural vegetation. In this study, a multilayer oil palm subroutine is developed in CLM4.5 for simulating oil palm's phenology and carbon and nitrogen allocation. The oil palm has monopodial morphology and sequential phenology of around 40 stacked phytomers, each carrying a large leaf and a fruit bunch, forming a natural multilayer canopy. A sub-canopy phenological and physiological parameterization is thus introduced, so that multiple phytomer components develop simultaneously but according to their different phenological steps (growth, yield and senescence) at different canopy layers. This specific multilayer structure was proved useful for simulating canopy development in terms of leaf area index (LAI) and fruit yield in terms of carbon and nitrogen outputs in Jambi, Sumatra (Fan et al. 2015).

The study supports that species-specific traits, such as palm's monopodial morphology and sequential phenology, are necessary representations in terrestrial biosphere models in order to accurately simulate vegetation dynamics and feedbacks to climate. Further, oil palm's multilayer structure allows adding all canopy-level calculations of radiation, photosynthesis, stomatal conductance and respiration, beside phenology, also to the sub-canopy level, so as to eliminate scale mismatch problem among different processes. A series of adaptations are made to the CLM model. Initial results show that the adapted multilayer radiative transfer scheme and the explicit represention of oil palm's canopy structure improve on simulating photosynthesis-light response curve. The explicit photosynthesis and dynamic leaf nitrogen calculations per canopy layer also enhance simulated CO_2 flux when compared to eddy covariance flux data. More investigations on energy and water fluxes and nitrogen balance are being conducted. These new schemes would hopefully promote the understanding of climatic effects of the tropical land use transformation system.

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