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Geoscientific Model Development Discussions

Interactive comment on "Representing anthropogenic gross land use change, wood harvest and forest age dynamics in a global vegetation model ORCHIDEE-MICT (r4259)" *by* Chao Yue et al.

Anonymous Referee #1

Received and published: 1 August 2017

General Comment:
This study touches on the issue of the representation of shifting cultivation in the dynamic vegetation model. The new model features including a better description on PFTs (plant function types) demography, wood harvest and shifting cultivation at a subgrid scale. The behavior of the enhanced model was tested both at a small scale and at a regional scale over an old growth forest (Miombo/dry woodlands) in South Africa. The model result shows that the new development has a robust representation of shifting cultivation during a long-term simulation period and the carbon emission due to

the land use change has been underestimated without the consideration of gross land use change (including shifting cultivation, age class PFT and wood harvest). The most important term for this net emission is contributed from the biomass burning due to shifting cultivation activities (the F_{Inst} term in Eq. (3)). The manuscript was written in a good shape with a detail model description and its experimental design, and the new model feature opens the opportunities for the scientific community to study the research issue such as the effects of shifting cultivation between different biomes on the climate from different soil types and climate zones.

Specific Comment:
I suggest the authors to provide a more detailed description and adequate reference of each term in the Eq. (3), which are the crucial parts of mathematical representation for the bio-physical/chemical processes. For example, the "F_{HR}" term is often parameterised as function of surface temperature, and it also could be parameterised as function both of surface temperature and soil moisture (Chang et al. 2008). In the view of result presented by the authors, "F_{Inst}" term is the major source of the net CO2 emission from the shifting cultivation between forests and croplands. I would also like to understand the sensitivity of this term to the state variables, such as soil temperature, soil carbon stock and ect. in the model.

In this paragraph (P8L241-L245), I was confused about the description of the recruitment in a forest. Does the natural recruitment in a forest increase the original forest cover fraction (Diluted the carbon stock)? Or, the forest cover fraction is always fixed and the recruitment only increases the carbon stock.

The author choose a dry woodland as an example to demonstrate the model behavior of shifting cultivation at a dry and warm climate zone. Regarding to the design of the land surface model (ORCHIDEE) is for a large scale study, I think it would be able to apply this new feature for a tropical peat land forest and the model behavior should be also welcome and interesting for the readers in the Earth System Modeling community.

Reference:
Chang, S.-C., K.-H. Tseng, Y.-J. Hsia, C.-P. Wang, and J.-T. Wu. 2008. Soil respiration in a subtropical montane cloud forest in Taiwan. Agric. Forest Meteorol. 148: 788-798

Technical Comment:
P2L59: the definition of "M" $10^6(million) or 10^9(mega)$?

P2L65: reference of "Hasis et al. 2015" is missing the reference list

P4L110: Some recent developments. . ., please cite more references

P5L158: . . ."Fig 1d". . . to . . ."Fig. 1d". . .

P8L239: . . .are properly defined. Please explain how to define the criteria for the cohort thresholds.

P9L279: the index i, j have been already used. It should be replaced by another indices, such as k, l. P13L395, L404: The description of F_{Fire} for Eq. (3) is missed.

P13L414: . . ."simulations and Le Quere et al. (2016)". . . I suggest to rephrase it to . . ."simulations and the existing global carbon budget dataset (Le Quere et al., 2016)".

P15L473-L474: six CFTs but only five ages (3, 9, 15, 30, 50) in the text

P15L481: the reason for choosing 65

P19L599: The Fig. 9 sub-index for "b" can't find the Figure 9. Please revise it for the consistence between the context and figure.

P21L667-L669: Please give an example for the possible missing process in the land use change.

P22L702: The citation of "Hurtt et al. 2016" is not in the reference list.

P22L711: Typo: . . .O"R"CHIDEE-MICT. . .

P22L723: . . ."is need to streamline land use". . . This is a bad English structure. I would

recommend to rephrase it as . . ."is needed to streamlining to land use". . .

P23L734-L736: It is a sentence with a bad English structure. Please rephrase it.

P33L989: Add a line for "S_{age}" simulation. I was confused about the zero cover fraction for both Cohort4 and Cohort5. For a 100 year simulation, the Cohort4 and Cohort5 supposed to have dynamic changes in the cover fraction. Pease explain the zero cover fraction for Cohort4 and Cohort5 in the main text.

P36L1014: Please check the label of the Fig.9. sub-label "b" is missed.

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