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Interactive comment on "A vertically discretised canopy description for ORCHIDEE (SVN r2290) and the modifications to the energy, water and carbon fluxes" *by* K. Naudts et al.

Anonymous Referee #1

Received and published: 3 January 2015

Comments on "A vertically discretized canopy description for ORCHIDEE (SVN r2290) and the modifications to the energy, water and carbon fluxes" submitted by K. Naudts to Geoscientific Model Development Discussion.

General comments This manuscript presented a new version of ORCHIDEE including a new canopy scheme (-CAN) applicable to forest management simulations. As claimed by the authors, forest management is one of the most important and uncertain factors in the global terrestrial carbon cycle, affecting the future climate change. For example, recent carbon-related debates on climate change mitigation, such as REDD+ and BECCS, are deeply related to forest management. The development of the ORCHIDEE-CAN seems to be a great progress toward taking account of forest

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management in global terrestrial models. The manuscript seems a bit lengthy, because model structure, parameterization, and validation were described separately for each process such as allocation and energy budget. I recommend revising the structure of manuscript in a more simplified manner. Another concern on the manuscript is that more validation (e.g., site-level comparison with filed data) would be necessary for this kind of study. Also, an intimate comparison with other models (e.g., ORCHIDEE-trunk and ORCHIDEE-FM by Ballassen et al.) is strongly recommended to clarify characteristics of the new model. Although the authors showed region-level, snap-shot comparisons with data, I could not be convinced that the new model simulates long-term transition of carbon budget including the impacts of human and natural disturbances. In conclusion, this manuscript needs major revision before being accepted for publication.

Specific comments Page 8568 Line 3–4 In addition to Dixon et al. (1994), Pan et al. (2011, Science 333, 988–993) should be cited.

Page 8568 Line 18 By definition of albedo, "darkness" should be replaced by "reflectance" or "whiteness".

Page 8569 Line 5–6 The statement "Vegetated surfaces are sub-divided in patches of different plant functional types" would be incorrect. Several DGVMs (e.g., LPJ-Guess and SEIB-DGVM) have individual-based vegetation dynamics.

Page 8571 Line 11–12 "to confirm convergence" Do you mean stabilization of carbon budget or agreement between the different spin-up methods? This statement is ambiguous and I recommend clarifying.

Page 8578 Line 5 For "sapwood area", do you mean "sapwood cross-section area"? Please clarify.

Page 8580 Line 10 Eq. (15) Please add a reference for Eq. (15).

Page 8581 Line 24 A recent study (Sun et al. 2014, PNAS 111, 15774–15779) implied that leaf mesophyll conductance in DGVMs. Your new model, ORCHIDEE-CAN, does

not include mesophyll control in the hydraulic architecture. Is it correct? If so, please discuss potential uncertainties due to neglect of the mesophyll conductance.

Page 8584 Line 14–16 What kind of numerical method was used to get a solution by iteration (e.g., the Newton-Raphson method)?

Page 8585 Line 21–22 No symbol in Eq. (29) has overbar. Please check.

Page 8590 Line 16–17 "Rs,i ... may be calculated using...". What do you mean for "may be calculated"? Do you mean "was calculated"?

Page 8591 Line 20 Remove ")" after "model".

Page 8593 Line 4 No natural disturbance such as wildfire, insect outbreak, and windthrow, was explicitly included in the present model. It is correct?

Page 8597 Line 25 Can you give a list of the 126 site observations as a supplementary material?

Page 8597 Line 28 What is the definition of "acceptable GPP"? Please explain. Otherwise, replace "acceptable GPP" by other words such as "GPP sufficiently close to observations".

Page 8604 Line 11–13 I agree the statement that there is no data-derived net carbon flux data. However, there should be soil carbon stock maps (e.g., Harmonized World Soil Database) that can be used for model validation. In this regard, there is a need for carbon spin-up.

Page 8606 Line 20 Additionally, the ORCHIDEE-CAN might have a few tuning parameters (e.g., plant water storage and soil-root resistance, p 8598 line 14–15), leading to higher likelihoods. If correct, this fact should be mentioned.

Page 8612 Line 7 Can you show "this finding" by some materials (e.g., figure or map)?

Page 8613 Line 14–16 I don't agree with the statement that "PFTs have no mean-

ing outside the modeling community", because plant biologists use a similar concept called "guild". Also, the concept of "functional group" has been widely used in plant ecophysiology (e.g., W. Larcher 1995, Physiological Plant Ecology, ecophysiology and stress physiology of functional groups, 3rd ed., 506 pp., Springer-Verlag). As there are more than 200,000 plant species on the Earth, global models inevitably use some simplifications such as the concept of PFTs, for the time being.

Page 8637 Table 3 Several values in Table 3 is "Table 3". Do you mean Table 4, 5, or 6? Otherwise, please explain.

Page 8646 Figure 2 and Page 8647 Figure 3 Please add units to each y-axis.

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Interactive comment on Geosci. Model Dev. Discuss., 7, 8565, 2014.