

Interactive comment on “Dynamic coupling of regional atmosphere to biosphere in the new generation regional climate system model REMO-iMOVE” by C. Wilhelm et al.

Anonymous Referee #1

Received and published: 22 July 2013

General comments

This paper is a "Development and Technical paper" within the scope of GMD. It is well written in terms of documenting the new model components (more interactive/prognostic and surface/vegetation) and major differences in the simulations between with and without the new components. This paper will be a good reference for those using REMO-iMOVE or relevant models in the future.

In terms of science, I do not find particular innovations or new contributions to the community mainly because more complex and advanced studies/models are already documented (which should be cited in this manuscript).

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My main suggestions are:

1) please be clearer on whether this model does or does not include vegetation dynamics, in which the areal coverage of PFTs and their carbon storage pools dynamically changes. This feature seems to be included in JSBACH according to the two cited papers, but the description of the model in P3090-3091 suggests that the PFT cover is fixed. On the other hand the authors wrote "The differences in the results of the two model versions stem from the differences in the dynamics of vegetation cover and density. . ." in the abstract.

2) please explain how the model calculates dark respiration to obtain NPP. Even though NPP is one of the key topics in this paper, the details of the respiration modeling is not given.

3) the discussion section needs to refer to other similar studies, realizing that the modeling system represented in this study is not quite state-of-the-art. Not only the bucket-soil water model, but also the representation of vegetation is not novel in the current context of regional climate modeling. I give some references below.

4) the writing in discussion section (and section 5.2.1) is not as good and careful as the other sections. The current discussion section seems more like a bullet list, summarizing each finding from the result section (partly because good discussions are already given in the respective result sections). Please go through them more thoroughly, paying attention to the use of commas, unnecessary words, and the structure of each paragraph; I believe each paragraph has to have one main point.

specific comments:

P3088, L13-14 Based on the lack of dynamic vegetation in this model, I disagree to use the term "comprehensive vegetation representation"

P3090, L4-5 "The coupled version REMO-iMOVE received the most important biophysical parameterizations for vegetation modeling of JSBACH" This (most important) is a

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vague statement and seems exaggerating without much context or references given.

p3091, L1 is "biotemperature" just a climatological annual mean temperature?

p3093, L19-20 How does the model calculate dark respiration? References for photosynthesis is given but those for respiration are not.

p3095, L14 "non-zero k and q = 0"

How can you have this condition since equation (5) is given as $k = q \times [NPP+] \times [SLA]$

p3096, L6-7, L9-10 maximum rate ($\eta_{bare} = 20\%$) "the resistance against bare soil evaporation will take a lower value ($\eta_{bare} = 45\%$)"

I suppose "lower" in this sentence should be "higher", compared to the 20% of the soil resistance in the previous sentence.

p3096, L22-23 "without loss of computational performance" This expression does not seem accurate. I believe there must be some increase in the computational time by coupling to JSBACH (i.e., REMO vs REMO-iMOVE).

p3097, L13 Please clarify what the surface vegetation ratio is.

p3097 L27 "so-called perfect lateral boundary conditions" I am not familiar with this term, "perfect lateral boundary conditions". What are they?

p3099-3102 (section 5.1.1-5.1.3) The description in these three sections seem to be too detailed, and certainly not an "overview" as stated in the section title. Probably it is better to focus more on the two main regions (described in p3102, L27 - p3103, L7) for the readability.

p3103, L16~ The description of albedo change does not seem correct here . I believe the albedo of the snow-covered forest is higher (thus more reflection) with lower temperature and lower with higher temperature (snow melts and more tree leaves are exposed). So,

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"For $T_s \leq 10 \text{ }^\circ\text{C}$ the albedo is fixed to a maximum value for $\alpha_{\text{snowforest}}$." should be "For $T_s \leq -10 \text{ }^\circ\text{C}$ the albedo is fixed to a maximum value for $\alpha_{\text{snowforest}}$." (minus sign in front of 10).

Also, "For $-10 \text{ }^\circ\text{C} < T_s < 0 \text{ }^\circ\text{C}$ the snow albedo increases linearly until the minimum value of $\alpha_{\text{snowforest}}$ is reached at $T_s=0 \text{ }^\circ\text{C}$." should be "For $-10 \text{ }^\circ\text{C} < T_s < 0 \text{ }^\circ\text{C}$ the snow albedo decreases linearly. ...".

P3104, L9- In figure 10 the sensible heat looks decreased over the areas with reduced LAI and VGR, which is the opposite to the description in this sentence. Is the color scheme (sign) correct for the panels of sensible heat?

p3105 , L10-12 " This effect is long known (Betts et al., 1997; Avissar and Pielke, 1991), but so far not modeled in detail, using a high resolution regional climate model." The latter part of this sentence is not correct. As I suggested for discussion section, there are already several studies that include the ecophysiological aspect of the vegetation in regional climate models. Examples are:

Beltrán-Przekurat, A., C. H. Marshall, and R. a. Pielke (2008), Ensemble reforecasts of recent warm-season weather: Impacts of a dynamic vegetation parameterization, *Journal of Geophysical Research*, 113(D24), D24116, doi:10.1029/2007JD009480.

Winter, J. M., J. S. Pal, and E. a. B. Eltahir (2009), Coupling of Integrated Biosphere Simulator to Regional Climate Model Version 3, *Journal of Climate*, 22(10), 2743–2757, doi:10.1175/2008JCLI2541.1.

Steiner, A. L., J. S. Pal, S. a. Rauscher, J. L. Bell, N. S. Diffenbaugh, A. Boone, L. C. Sloan, and F. Giorgi (2009), Land surface coupling in regional climate simulations of the West African monsoon, *Climate Dynamics*, 33(6), 869–892, doi:10.1007/s00382-009-0543-6.

Smith, B., P. Samuelsson, A. Wramneby, and M. Rummukainen (2011), A model of the coupled dynamics of climate, vegetation and terrestrial ecosystem biogeochemistry for

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regional applications, *Tellus A*, 63(1), 87–106, doi:10.1111/j.1600-0870.2010.00477.x.

Davin, E. L., R. Stöckli, E. B. Jaeger, S. Levis, and S. I. Seneviratne (2011), COSMO-CLM2: a new version of the COSMO-CLM model coupled to the Community Land Model, *Climate Dynamics*, 37(9-10), 1889–1907, doi:10.1007/s00382-011-1019-z.

Stéfanon, M., P. Drobinski, F. D'Andrea, and N. de Noblet-Ducoudré (2012), Effects of interactive vegetation phenology on the 2003 summer heat waves, *Journal of Geophysical Research: Atmospheres*, 117(D24), n/a–n/a, doi:10.1029/2012JD018187.

p3106, L21- p3107, L3 Why do you refer to the literature values for tropical grassland while you focus on different ecosystems? What is the main statement of this paragraph?

p3108, L23-25 What is the point of this paragraph/sentence?

p3109, L1-9 Please provide the conclusion for this paragraph.

Together with the above three comments, I'd like to point out that section 5.2.1. is really hard to read, and this particular section does not provide much insights or main points. I suggest moving one paragraph in discussion section (p3110, L12-27) to the end of this section to provide a summary.

p3110, L10 (also in p3106, L14) I cannot find the appendix mentioned in these sentences. Or do you mean Figure 12?

p3111, L10-11 Bonan et. al. (2011) is a good reference for this sentence. Bonan, G. B., P. J. Lawrence, K. W. Oleson, S. Levis, M. Jung, M. Reichstein, D. M. Lawrence, and S. C. Swenson (2011), Improving canopy processes in the Community Land Model version 4 (CLM4) using global flux fields empirically inferred from FLUXNET data, *Journal of Geophysical Research*, 116(G2), 1–22, doi:10.1029/2010JG001593.

Table 1 What the numbers in parentheses as in "desert (7)"?

Tables 4 and 5 Are these observed or simulated values? What are the two rows?

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Different years or PFTs?

Figures 4, 5, 6, 7, Please make the font size larger for the color-bar. The numbers are very hard to see. Also, can you rotate the numbers 90° clockwise?

Figure 11 the font sizes for the axes and tick mark labels, legend are all too small.

Figure 12 I needed to zoom in Figure 12 by 400% using Acrobat reader, but then the legend looks blur since the resolution of the graphic is limited. It would be better to use other ways to summarize the results from all the sites, such as Taylor diagram, and show only a few examples of the time series to illustrate the key points.

"technical corrections"

p3095, L18, wording "The begin of the vegetative phase" should be "The beginning of the vegetative phase"

p3103, L26 "The snow reduction of the masking effect" This wording seems incorrect. Should be "The reduction of snow masking effect" ?

Figure 10, typo in the caption "vegetation ration (VGR)" should be "vegetation ratio"

Interactive comment on *Geosci. Model Dev. Discuss.*, 6, 3085, 2013.

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