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Interactive Comment

Interactive comment on "Coupling between the JULES land-surface scheme and the CCATT-BRAMS atmospheric chemistry model (JULES-CCATT-BRAMS1.0): applications to numerical weather forecasting and the CO_2 budget in South America" *by* D. S. Moreira et al.

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We thank the referee #2 for their comments. which are addressed below:

1. **"I can summarize this paper: we replaced LEAF with JULES and ran BRAMS" Thats fine"**

   We actually did not replace LEAF by JULES, but included in CCATT-BRAMS

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Interactive Discussion
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model a new option of surface scheme. So, the users are now able to choose to run either with LEAF or JULES. Several reasons pushed us to do that, for example in-line and interactive CO_2 biogenic flux, BVOCs, reliable treatment of urban processes and updated formulations for realistic simulation of surface fluxes. JULES within CCATT-BRAMS allows the simulation of a new set of scientific problems related to atmosphere-biosphere interactions, which could not be tackled with LEAF.

2. **I'd rather see this new coupling used to explain something about South American meteorology and/or ecophysiology.**

   As stated in the Abstract (p. 455, line 22): The goal of this article is to present to the scientific community a free modeling tool that allows the study of several relevant scientific questions (some of them you have mentioned). At this moment, we are using this modeling tool to simulate the rectifier effect and to study the impact of biomass burning aerosols on CO_2 biogenic fluxes during biomass-burning season in South America.
   As explained by the Editor, we selected GMD journal exactly because the aim of this article are not study meteorological processes but to document the development and evaluation of coupled models like JULES-CCATT-BRAMS. See in http://www.geoscientific-model-development.net/home.html the aims this journal: "*Geoscientific Model Development (GMD) is an international scientific journal dedicated to the publication and public discussion of the description, development and evaluation of numerical models of the Earth System and its components.*",

3. **"Also, MODIS data from 2001-2002 is used to prescribe phenology, but cases from 2010 were simulated"**

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We agree that the ideal would be using NDVI correspondent to same year of the simulation. But the NDVI in Amazon region does not change substantially over the years and the work of getting NDVI from MODIS and ingesting in the model is not trivial. Besides that, we used the same NDVI to run both JULES and LEAF. Thus, the comparison between the two is consistently valid.

4. **I also wonder about the choice to aggregate all of the observation/model datapoints into a single plot. I realize this can save space, but we know there is large variability across Amazonia, as both da Rocha et al. (2009) and Costa et al. (2010) describe transitions from water-limited to light-limited regimes across vegetation and moisture gradients in the basin. Is the improvement shown by replacing LEAF with JULES consistent across these gradients, or is there regional variability across the cerrado to the transition forest to the interior forest?**

   We agree that there is a large variability across Amazon, but our goal here is to show the coupled system and its general performance over South America. Future scientific work discussing the variability of the performance across Amazon making links with climate and ecophysiologic processes are expected applications for the numerical tool presented here.

5. **Offhand, I can think of several interesting science questions that might have been addressed with this model. For example:**

   Great! We agree that now is possible to address several interesting science questions using JULES-CCATT-BRAMS. We are looking forward to have new users to this modeling system publishing scientific papers as this model will be freely available to the scientific community.

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1 Some specific comments:

1. **Page 456, lines 7-8: Amazonia has been one of the largest contributors to atmospheric CO2 removal. Are you sure about that? Inversion studies show that whether tropical SA is a source or sink is not known (Stephens et al., 2007; Gurney et al., 2008), and uncertainty is large. I think that it is well-established that tropical SA has a strong influence on the global CO2 growth rate in a given year (Rayner and Lawy, 1999; Bousquet et al., 2000; Friedlingsteing et al., 2006; Baker et al., 2006). This statement is provocative, and needs more than a single reference to justify it.**

   We agree that this issue has not been concluded yet. Observe that in p. 456 line 7, was wrote *"and studies suggest that Amazonia has been one of the largest contributors to atmospheric CO_2 removal"*

2. **Page 457, line 13: I would not call LEAF an "outdated surface model", as that phrase is somewhat derogatory to the LEAF developers. LEAF was a fine landsurface module, but has been surpassed as our knowledge increases. I might suggest that the authors use wording that lauds JULES for more explicitly resolved features, and the fact that it reflects the advances in our understanding of terrestrial biophysics that have been made in the last decade or so: praise JULES, as opposed to bad-mouthing LEAF. There are several instance in the text where this change might be made.**

   The phrase: "Thus, this work has as its main goal the replacement of an outdated surface model (LEAF), with a current model (JULES) with several new simulated processes that is in constant development by dozens of renowned researchers." was replaced by: "Thus, this work has as its main goal to include in CCATT-BRAMS model a new option of surface scheme (JULES), able to simulate additional processes not included in LEAF and within the state-of-the-art of the

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physics."

3. **Equation 1: multiple instances of an identical term (ds(bar)/dt) do not really assist the reader; I suggest a conceptual equation, where the terms are shown in a qualitative manner (mixing ratio = advection + PBL diff + deep conv...)**

   We agree that the equation was not visually pretty. However, we have been using it in the same way in others papers and would like to keep it in that way.

4. **lines 11-12: as well as not does not cause... Looks like a typo that needs to be fixed.**

   Replaced to: "as well as not causing"

5. **Page 460, lines 18-19: should be Reid et al. (1998).**

   Fixed.

6. **Page 461, line 13: JULES is composed of MOSES and TRIFFID. MOSES has many characteristics in common with the models that Saleska et al. (2003) demonstrated were unable to capture the seasonal cycle of carbon flux at Tapajos (K67,K83). Furthermore, Hadley Centre runs using JULES show a positive temperature bias in Amazonia (Huntingford et al., 2004). This suggests that JULES generates unrealistic vegetation stress during the dry season, which will influence the Bowen ratio, and therefore the weather in the model using JULES as a lower boundary. Has JULES been evaluated against eddy covariance flux towers in Brazil? Does it capture observed annual cycles of carbon flux, latent and sensible heat? If so, then citations**

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to that effect would be appropriate. If not, that might be another science application that would make the paper much more interesting.

We are not aware about JULES evaluation with eddy covariance flux towers in Brazil. However, we are planning to this kind of direct comparison. The results in figure 10 indicate that the daily cycle of carbon flux was fairly well simulated for that time period. Therefore, it seems fair to say that the model is likely able to simulate well also the annual cycles. Latent and sensible heat influence directly the 2m-temperature and it has been shown that JULES provided a gain compared to LEAF.

7. **Page 462, lines 9-10: where trees normally earn of grasses... I don't understand what that means.**

   The phrase in line 10 explains: "Therefore, the dominant types limit the expansion of subdominant types.", ie, in a competition trees usually wins grasses.

8. **Page 464, lines 5-15. Is NDVI from MODIS used, instead of MODIS LAI/fPAR products? If so, a reference to how NDVI is processed into model parameters would be appropriate (e.g. Sellers et al.,1996). Also, cloud masking of spectral indices is a real issue in this part of the world (Sellers et al., 1996, Los et al., 2000). A citation or short description of how this issue is dealt with would be appropriate.**

   In JULES we introduced the use of NDVI to derive model parameters in the same manner as is used in LEAF (which follows the formulation of Sellers et al 1996). We did not find any information in there about how cloud masking of spectral indices is done.

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9. **Page 465, lines 14-16: I understand the difference between experiments, but I'm not sure I understand the difference between the 30/31 members.**

   In line 15, say: "(3 experiments with 31 members each, one member per day) for March 2010". March have 31 days and September have 30 days, so will be run 31 simulations to March and 30 to September.

10. **Page 466, lines 20-22: This sentence is redundant.**

    We think that this phrase is important to introduce the equations, so we will keep it.

11. **Page 468, lines 4-18: A negative temperature bias suggests (perhaps) an anomalously small Bowen ratio. Is this true? If so, JULES is a departure from most other models, which are biased positive (hotter) when compared to obs. This is very interesting, and might be fleshed out a little bit. Possible reasons for bias would be radiative transfer or transpiration, and comparisons at flux towers (see Lu et al., 2005) might be instructive.**

    Surely there are a number of factors that may have contributed to the negative bias. But both LEAF and JULES generated a negative bias during daytime. So, we suspect the causes may be issues not specifically related to the surface model, which must be addresses in future work.

12. **Page 475, lines 13-14: the simulations of vertical profiles over 4 sites of Amazon basin and for wet and dry seasons did not show very accurate agreement... It seems to me that in some cases the agreement is good, other cases not so. I'd like to see some discussion of this and analysis of where the disagreement might come from.**

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This discussion is on page 473, lines 3-9 and 11-16.

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