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Interactive comment on "The Yale Interactive terrestrial Biosphere model: description, evaluation and implementation into NASA GISS ModelE2" *by* X. Yue and N. Unger

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We thank Dr. Kiang for her interest in our manuscript and the YIBs model. Some of her statements are misguided and confused. YIBs is a standalone land carbon cycle model developed at Yale University independent of GISS. YIBs has been implemented into the IPCC AR5 frozen version of NASA GISS ModelE2 documented in Schmidt et al. (2014) on which Dr. Unger is a co-author. We developed ModelE2-YIBs to study carbon-chemistry-climate interactions, for instance to quantify the effects of atmospheric ozone and aerosols on the terrestrial biosphere and, in turn, the changing land biosphere effects on surface air pollution and chemical radiative forcing of climate.

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The NASA GISS ModelE2 version in Schmidt et al. (2014) that was used for the IPCC AR5 and CMIP5 experiments did not incorporate YIBs, but included a vegetation scheme called "Ent". There is a cursory equation-less description of Ent in Section 2.6 of Schmidt et al. (2014) but the land carbon fluxes were not presented or validated in that paper. To our knowledge, the land carbon fluxes in the vegetation scheme incorporated in Schmidt et al. (2014) have not been presented or evaluated anywhere in the peer-reviewed scientific literature. The vegetation scheme in Schmidt et al. (2014) does not include any working C4 photosynthesis, prognostic LAI, dynamic tree growth, carbon allocation, soil biogeochemistry, ozone vegetation damage, or BVOC emissions. In addition, the land scheme in Schmidt et al. (2014) uses a vegetation cover map from Matthews (1983). Therefore, it is completely inappropriate to cite Schmidt et al. (2014) for any other purpose than the global chemistry-climate model components used in our paper.

We address the short comments in detail on a point-by-point basis below.

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These corrections should be made to citations for vegetation biophysics and soil respiration. Section 3.1 Vegetation biophysics The ModelE2 vegetation biophysics section needs to be corrected for the following. p. 3152, line 15: The paragraph should open with the sentence, "The vegetation leaf and canopy biophysics are as described in Schmidt et al (2014), and we provide details and modifications here."

→ The YIBs leaf and canopy biophysics are from Unger et al. (2013) and Yue and Unger (2014), and not Schmidt et al. (2014). For example, Schmidt et al. (2014) does not include C4 photosynthesis. The land carbon fluxes for that vegetation scheme have never been presented, evaluated or validated in peer-reviewed scientific literature. In contrast, YIBs includes C4 photosynthesis, and the canopy biophysics and land carbon fluxes have been extensively validated against 40 North American flux tower sites in Yue and Unger (2014) and 145 flux tower sites and multiple satellite products in this

work.

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p. 3154, lines 1-2: Replace with, "where Rd is the rate of dark respiration, for which we modified the ModelE2 specification of 0.015 Vcmax (Caemmerer 2000) to 0.11 Vcmax for C3 plants (Farquhar et al 1980) and 0.025 Vcmax for C4 plants (Clark et al. 2011)."

$\rightarrow$ ModelE2 cannot claim credit for the Vcmax parameter. We correctly define and appropriately cite the YIBs Vcmax specifications that are based on literature research and our own site-level evaluations.

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p. 3154, lines 12-15: The solution to the coupled photosynthesis-stomatal equations in ModelE2 is not by Baldocchi (1994), but is an entirely different solution by Dr. Igor Aleinov. Also, both schemes solve for A and not for ci. This citation is also incorrect in Unger et al. (2013). The sentence needs to be replaced with: "The coupled equation system of photosynthesis, stomatal conductance and CO2 diffusive flux transport equations form a cubic of A that is solved analytically (Igor Aleinov, unpublished, as part of ModelE2). We note that the citation of Baldocchi (1994) for the cubic solution in Unger et al. (2013) is an error."

$\rightarrow$ Unger et al. (2013) is in fact the correct reference for the solution to the coupled photosynthesis-stomatal equations applied in YIBs and will be added in the revised manuscript. We correctly cited Baldocchi (1994) out of respect because that was the first published solution in the modeling field. Dr. Aleinov wrote the code for the cubic solution in YIBs and as such is a major co-author on Unger et al. (2013). Dr. Aleinov provided substantial comments on Unger et al. (2013) and concluded that "it is a really nice paper". Dr. Kiang is a major co-author on Unger et al. (2013) for her helpful contributions to the biophysics development used in YIBs. The initial biophysics scheme did solve for ci but has since been changed to A.

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Section 3.2.4. Other PFTs p. 3159, lines 8-10: Re: "We implement a parameterization for the impact of cold temperature (frost hardening) on the maximum carboxylation capacity (Vcmax) so as to reduce cold injury for ENF during winter (Hanninen and Kramer, 2007)." Replace the above with one of the following: "We parameterize the frost-hardening scheme of ModelE2 (Schmidt et al 2014) with <please fill in – what parameter was changed?> "The reduction in winter maximum carboxylation capacity (Vcmax) in ENF to reduce cold injury is the frost hardening scheme as described in Schmidt et al (2014)."

→ The YIBs frost hardening scheme was introduced in Section 2.1.1 of Unger et al. (2013) and we presented it again in this study for the completeness of the model descriptions. Again, ModelE2 cannot claim credit for this frost hardening scheme.

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Section 3.4 Soil respiration The appropriate citation for the CASA model is Potter et al (1993), not Schaefer et al. (2008), which cites Potter et al. for part of a coupled model. This section only describes the soil carbon pools and their exchanges in the CASA model, but does not give what responses to temperature and soil moisture are used. Since this is a separate submodel, equations 27-31 are unnecessary detail. However, the temperature and soil moisture responses are often implementation-specific, so some description should be provided. Also, the parameterization of litter quality should be documented in Section 3.3 Carbon Allocation, because this is critical to the behavior of CASA. The CASA model was implemented in ModelE2 by developers at GISS and not by the authors. The temperature and soil moisture responses of respiration are unpublished derivations from data, to be published in forthcoming manuscripts on the carbon cycle in ModelE2. Therefore, the text should be revised as follows: "The soil respiration scheme is that implemented in ModelE (Kharecha et al 2007) based on the Carnegie-Ames-Stanford Approach (CASA) model (Potter et al 1993), with modifi-

cations to the respiration responses to soil temperature and moisture re- derived from data of Del Grosso et al (2005) (Kiang, personal communication). The CASA model partitions carbon flows among 12 biogeochemical pools. Three live pools. . ."

→ We agree that Potter et al. (1993) needs to be cited here. We retain Schaefer et al. (2008) because we adopted their updated specifications. The parameterization of litterfall is shown in Equation (26) in Section 3.3 and is from JULES.

We were not familiar with Kharecha et al. (2007) until this comment. This citation appears to be an AGU abstract. In any case, to our knowledge there is no functioning soil biogeochemistry scheme in the land component of the Schmidt et al. (2014) version of NASA GISS ModelE2 and it doesn't seem to be mentioned in Section 2.6 of Schmidt et al. (2014).

The Carnegie-Ames-Stanford Approach (CASA) model is a mature, well-established, well-used model and has been implemented into YIBs as an "off-the-shelf" package, unlike the phenology for which we explored 13 schemes available in the published literature. In the current paper, we focus on the introduction of the basic processes in CASA. Of course, we agree that the temperature and moisture responses are an exciting active research topic, especially for those researchers studying long-term carbon-climate interactions. A microbial soil science research group at Yale intends to pursue soil respiration issues using the YIBs model in conjunction with their new measurement data.

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