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Biogeosciences Discussions

Interactive comment on "Intercomparison of Terrestrial Carbon Fluxes and Carbon Use Efficiency Simulated by CMIP5 Earth System Models" *by* Dongmin Kim et al.

Anonymous Referee #1

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General Comments

This paper is a model comparison of 10 ESMs with satellite data from MODIS. The novel contribution of this paper is that is breaks down the analysis of model differences and biases by PFT. Similar comparisons of NBP, GPP, and CUE have been done already, as described in the Introduction section (Anav et al. 2013, Shao et al. 2013, Zhang et al. 2014).

I thought an interesting and underemphasized point was that reduced C uptake due to N limitation decreased CUE in models that added a representation of the N cycle, bringing up questions about whether we need coupled C and N or if so, whether the implementation in these models (reducing C uptake) is correct.

The writing is clear and the methodologies are described well, though the Results section is indeed largely results, as well as large portions of the Summary section. In the Specific Comments I asked some questions in places where I thought more discussion was needed. I think this paper could be improved with either a dedicated Discussion section or more development of the main findings and their implications. To me, the most interesting points in the paper are that: ESMs are biased in similar ways, CUE depends on climate (and therefore indirectly on PFT?), and the bias pattern of CUE differs in C-N coupled models.

Specific Comments

L63-68 That MME-values of CUE are dependent on temperature but MODIS-derived CUE is not suggests to me that we don't know what controls CUE in the real world. This is perhaps the more intriguing call to action than better model validation (because these models are clearly deficient, the question is why?).

L238 Clarify that "the only exception" refers to NPP calculated by GPP-Ra, not to the previous sentence about nitrogen cycling.

L279-293 Just to clarify: Did you use the model runs with their native PFTs, but then make Figures 12, S4 by breaking down the output by the classifications in Figure 1?

L326 I like Taylor diagrams, but I think you need a citation for the method.

L354 What do you mean by this statement? I think you need to clarify what "higher model performance" would be in this case (e.g., greater precision or accuracy). I also think that you could have large biases in individual models but still get a good mean estimate as long as those biases are different and random in each model, but I think your point is that many of the models are biased in similar ways.

L378-388 It is hard to identify whether biases are due to parameterization, or the climate forcings. Are there papers that use identical climate forcings to diagnose biases? I love to see some discussion here that tries to diagnose where biases come from using

previous studies.

L395 This may be the motivation for why you used it here, but it not the only reason to care about CUE: it is also an important control on the C cycle and may change under future climate or with land use.

L402-403 Explanation for why CUE is higher in cold weather? Growth more limited by access to C and respiration more limited by temperature?

L444 How do you know that nitrogen limitation effects CUE more than temperature and precipitation?

L450-453 The explanation for high needleleaf CUE in this paragraph is just a definition of CUE, can you provide a biophysical explanation?

L464-470 I think it's very interesting that models with C and N cycles simulate lower CUE. Seems to agree with theory that N limitation lowers CUE (Sinsabaugh et al. 2013 Ecology Letters).

L495-496 By what mechanism do these plants increase CUE?

L500 Seems from Figure 14 that the opposite is true: that ESMs don't respond enough to temperature, especially at >20C.

L527-529 Here you say that the parameterization is more important than the climate, which seems to be in contradiction to the uncertainty in L378-388.

Figures A lot of 9 panel maps are hard to look at and not all seem necessary. For example, Figure 10 does a much better job of summarizing the main points of CUE spatial distribution than doe Figure 9 (which could probably go in the Supplement).

Technical Comments L451 Do you mean "deciduous forests" instead of "dense forests"

L540 "In different with MODIS", suggest edit to "In contrast with MODIS".

Figures Can you label the multi-panel figures with letters (i.e., a,b,c..)

Figure 5 Remove title.

Figure 6 Why is there a red MODIS symbol in the legend?

Figure S4 Change 1. and 2. in legend to blue triange and green circle, respectively.

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