

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 #2

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Summary: This paper compares the GPP, NPP, and CUE of 10 CMIP5 models to an ‘observation’ from MODIS, and evaluates their similarities and differences. Model precipitation and temperature fields are similar to reanalyses, but carbon cycle products are diverse.

At the outset, I have a major problem with this paper. The only observation MODIS makes is radiances recorded by reflected sunlight in multiple spectral bands. MODIS does not ‘observe’ LAI, it calculates it with a model. MODIS does not ‘observe’ fPAR, it calculates it with an NDVI-type algorithm. MODIS does not ‘observe’ GPP, it models it using a light-response model (fundamentally different than the enzyme-kinetic models from CMIP5 that are evaluated here). MODIS most certainly does not ‘observe’ any

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form of respiration (R_a or R_h), but calculates these as a function of modeled GPP and equations that relate respiration dependence to temperature and moisture. To claim that MODIS-derived quantities are somehow correct compared to other models is just about impossible to defend. We know that MODIS has biases in that the radiances are masked during times of even fairly thin cloud optical depth. This has major impacts in the tropics (where area-mean GPP is just about the highest on the globe), in savanna regions where GPP can respond strongly and rapidly to seasonal rains, and surely in other regions as well. MODIS GPP/NPP/CUE is just another model. With this perspective, there's not a lot here other than demonstrating that the models are different, but we knew that already. Some of that analysis was already done in the Shao paper.

Furthermore, there are multiple instances where the grammar and prose are incorrect, especially in the conclusions section. I appreciate that to write a scientific manuscript in a non-native language can be a challenge, but there are resources to help with this. The authors must find and utilize these resources to ensure that the manuscript meets English language grammar and usage requirements. Peer-review is for scientific content, not proofreading.

For these reasons, I must recommend rejection of this manuscript. The assumption of MODIS 'correctness' permeates the document, and the grammar errors are too many to mention.

Suggestion: The authors have obviously put a lot of work into the analysis, and I believe it may have value as a resubmission. The idea of a comparison between the light-response MODIS model and the various enzyme-kinetic CMIP5 models interests me. I have not worked with the CMIP5 data directly myself, but I imagine that gridded CO₂ values are part of the output suite. I wonder if it would be possible to pull out gridcells that contain CO₂ flask sites and compare mean annual cycles from the models to those observations? I'm pretty sure I've seen MODIS-based predictions of global CO₂ fields, and this might provide an interesting comparison of models to an actual observation. I looked for an article like this in the currently published CMIP5

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literature, but did not find one. Perhaps an opportunity exists here. I do not think a full inversion or data assimilation project would be necessary, but perhaps something like Wang et al. (2016), where comparisons were made between models and observed CO₂ concentration at several flux sites.

Specific comments: $\hat{\text{A}}$ Map figures should be broken at the date line, not the prime meridian. Currently, a large fraction of the middle of these plots is blank Pacific Ocean, and it is hard to discern behavior in Africa and Europe. $\hat{\text{A}}$ Figure 2: it is not necessary to show both the 2000-2005 and 1983-2005 maps. You can show the 2000-2005 map and just say that the longer-period map is similar. $\hat{\text{A}}$ Reanalyses of temperature and humidity are observationally-based, but precipitation, even for a reanalysis is based at least to some extent on models. I'm not sure how reliable any global precipitation map is, even the observational/satellite products like GPCP or TRMM. 'Reanalysis' might be a better description than 'observation' in graphs like Figure 3.

Reference: Wang, Y., N.M. Deutscher, M. Palm, T. Warneke, J. Nothold, I. Baker, J. Berry, P. Suntharalingam, N. Jones, E. Mahieu, B. Lejeune, J. Hannigan, S. Conway, J. Mendonca, K. Strong, J.E. Campbell, A. Wolf, S. Kremser, 2016: Towards understanding the variability in biospheric CO₂ fluxes: using FTIR spectrometry and a chemical transport model to investigate the sources and sinks of carbonyl sulfide and its link to CO₂. *Atmos. Chem. Phys.*, 16, 2123-2138, doi:10.5194/acp-16-2123-2016.

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