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Interactive comment on "Global variability of carbon use efficiency in terrestrial ecosystems" *by* Xiaolu Tang et al.

Anonymous Referee #2

Received and published: 10 April 2019

The article studies the carbon use efficiency defined as the ratio of NPP and GPP for different ecosystem types. They used a machine learning algorithm (called "Random Forest") to predict CUE from global climate and soil variables. Their results were compared with simulation output from different DGVMs. They give some explanations about difference between model output and observation and point out the importance to check for variable CUE. The article is well written and organized and fits into the scope of the journal.

General remarks:

The author used data from the TRENDY model ensemble. The differences between observed and modelled CUE is explained by model deficiencies. However new model versions are now available. Within the ISIMIP2b project there exist more up-to date

model runs. The focus in the ISIMIP project is more on future climate projections, but there have also data available for present climate. The authors should add a discussion about this. The description of the machine learning algorithms is rather brief. The algorithm should at least be described in more detail in the supplement because it is a key part of the study. The authors show in Figure 4 the latitude dependence of modelled, observed and predicted CUE. In addition some quantitative statistical measures should be shown in a table.

More specific comments:

The authors should add a mathematical definition of CUE to the main text instead of the supplement: CUE:=NPP/GPP Furthermore Figure S1 might be moved to the main text

Page 11, line 315. It is stated that most models do not consider nutrient constraints, in particular nitrogen. However, there are models with explicit nutrient limitations. There exists a version of the LPJ-GUESS model (Smith et al. 2014, Biogeosciences), e.g., that takes nitrogen limitations into account. Also the JSBACH model used in this study has an updated version with nitrogen. Perhaps it is possible to include result from these updated models into their study.

Page 11, line 311. While growth respiration is generally set to a constant in DGVMs, maintenance respiration in LPJmL, e.g., depends on air/soil temperature and C:N ratios respectively.

Page 11, line 317. Increased CO_2 concentration leads to better water use efficiency and therefore lower water stress increasing the productivity in DGVMs. This lead in generally to an overestimate of the CO_2 fertilization effect because other limitation such as nutrient limitations are not taken into account. Please comment on that.

Page 13, line 376: Typo: land over instead of land cover

Page 13, line 378: Typo: TREDNY instead of TRENDY

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