

Geosci. Model Dev. Discuss., referee comment RC2
<https://doi.org/10.5194/gmd-2022-56-RC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on gmd-2022-56

Anonymous Referee #2

Referee comment on "The Earth system model CLIMBER-X v1.0 – Part 1: Climate model description and validation" by Matteo Willeit et al., Geosci.
Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-56-RC2>, 2022

Paper provides detail description of new version of CLIMBER model and evaluation of model performance for different historical periods, as well as model response to the changes in atmospheric CO₂ concentration. Present day climate, climate change over recent historical period (1850-2100) and response to both doubling and transient increase of the atmospheric CO₂ concentration simulated by CLIMBER agree well with available observations and results obtained with more sophisticated climate models. At the same time, there are noticeable differences in climate state for Last Glacial Maximum between CLIMBER and CMIP5 models.

This does not necessarily mean that CLIMBER is wrong, but in my view, additional validation would be useful. As said in the paper "The atmospheric component of CLIMBER X is based on a statistical-dynamical approach, which employs a number of significant simplifications and assumptions." The fact that "these simplifications and a set of parameterizations explicitly derived from present-day climate limit the models' applicability to climate states fundamentally different from the present one". Authors mention Snowball Earth case as such climate state. Possibly Last Glacial Maximum climate is also different enough from preset one.

As indicated in the paper "CLIMBER-X includes code to diagnose the strength of the different climate feedbacks". I would suggest calculating climate feedbacks for LGM climate and comparing them with estimates available in literature.

Specific comments.

There seems to be discrepancy between Table 1 and Table 2.

Total evaporation in Table 2 are larger than observation, while latent heat in table 1 is smaller

On page 14 (near line 355).

Following sentence: "During the winter months and at high latitudes, CLIMBER-X also captures the near-surface temperature inversions." It is better to say, "During the winter months, CLIMBER-X also captures the near-surface temperature inversions at high latitudes"