Response to reviewer #2

We would like to thank the reviewer for the comments on our paper. In blue below is our response to the reviewer comments and suggestions (in black).

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 CO_2 concertation. Present day climate, climate change over resent historical period (1850-2100) and response to both doubling and transient increase of the atmospheric CO_2 concentration simulated by CLIMBER agree well with available observations and results obtained with more sophisticated climate modes. 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 noted by the reviewer, there are indeed some differences in the simulated LGM climate between CLIMBER-X and CMIP models. Part of the differences could be a result of CLIMBER-X having dynamic vegetation, while many CMIP models don't. We will test the effect of the vegetation feedback by running an additional LGM simulation with prescribed present-day vegetation. We would also argue that when it comes to e.g. global cooling and AMOC state, CLIMBER-X results are possibly in better agreement with reconstructions than (some) CMIP models.
The LGM is definitely not outside of the applicability range of the model, as CLIMBER-X has been designed specifically also to simulate past glacial cycles. That is also the reason why we explicitly included a comparison of the simulated LGM state with state-of-the-art CMIP models in the paper. However, we will elaborate a bit more on the differences between CLIMBER-X and CMIP models in the revised paper version.

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.

We will perform a further feedback analysis for low CO2, to get a better picture of the state dependence of the climate feedbacks in the model.

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

This could be a result of the use of different observation-based estimates for the energy fluxes and for the hydrological cycle and thus ultimately a consequence of the uncertainty in these estimates. We will add a short discussion on this point in the revised manuscript.

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”

We will change the mentioned sentence accordingly.