

Interactive comment on “A comprehensive history of climate and habitat stability of the last 800 000 years” by Mario Krapp et al.

Anonymous Referee #2

Received and published: 20 September 2019

This manuscript uses a set of snapshot simulations with HadCM3 over the last 120kyr to build an emulator that then extends into the last 800kyr. In addition a few atmosphere only simulations at higher spatial resolution than the coupled HadCM3 covering the more recent period are used to add more spatial variation into the long time-scale climate emulation.

While the approach is novel and seem very promising to me, I have still some difficulties to understand how well this approach is actually validatable. Maybe this is (partly) due to my limited understanding, but from reading the text and the figures it becomes not clear to me whether the approach is justified and how large potential errors could be. Therefore, in its present form I cannot recommend the paper for publication.

Fig 5 should be the most convincing figure to show that the emulated climate gains
C1

quality because it uses – in addition to the HadCM3 snapshots covering the last 120kyr – additional information on spatial patterns from higher-resolution simulations. However, I get very confused by this figure and its discussion: Fig 5B shows GCMET-LO, while Fig. 5C shows LOVECLIM and GCMET. How can I see that GCMET (higher resolution I assume) does better in the spatial patterns than GCMET-LO and LOVECLIM?

Next, section 3 is meant to compare the emulated climate to proxy data. The overall (global) comparison is made in Fig 5A, while more detailed patterns are evaluated in Figs. 7 and 8. Fig 6 adds a (very useful) comparison to the present day climate by HadCM3. This whole section is again confusing. First of all, during the last 80kyr HadCM3 seems to be at the upper end of the data set (Snyder) in Fig. 5A, while in the reconstructed time period (before 140ka BP) blue and grey lines seem to match rather well. I don't see how we can account for a potential model bias (from the last 80kyr) in the earlier (emulated) period? Moreover, in the other figures it is unclear what is compared to LOVECLIM and what to GCMET-LO or GCMET? Why is the LOVECLIM simulation necessary here, as you also have a low resolution HadCM3 version?

Two more specific (but still general) remarks:

Line 153-54: Some patterns of climate variability most likely don't show up in the lower resolution snapshots. However, these might be very sensitive to orbital forcing and not only depend on just CO₂. I don't see how you get a reliable addition to the low-resolution version by just adding the high-low resolution difference based on CO₂ concentration.

Line 258: How important is it for the underlying snapshot simulations to be in 'quasi'-equilibrium? Can you estimate the error due to non-perfect equilibration of the training set?

Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2019-91>, 2019.