

Review of: Earth system model simulations show different carbon cycle feedback strengths under glacial and interglacial conditions

Adloff et al.

Overall evaluation:

The manuscript documents an Earth system model experiment comparing terrestrial carbon cycle feedbacks under Last Glacial Maximum (LGM) and pre-industrial initial conditions. The experiments suggest that the uptake of carbon under LGM initial conditions is stronger than under pre-industrial conditions.

The manuscript is in places poorly written and generally fails to provide a convincing rationale as to how the experiments increase our understanding of the Earth system. Additionally the authors seem ignorant of elementary concepts in climate science such as the definition of climate sensitivity or that the forcing from CO₂ is approximately a logarithmic function of concentration. Overall I recommend that the manuscript be rejected for publication in Earth system dynamics.

General Concerns:

(1) The paper is framed around exploring climate sensitivity under varying initial conditions of the climate system. However the authors appear unaware that climate sensitivity is the equilibrium change in global temperature from a doubling of atmospheric CO₂ concentration (IPCC AR5 Glossary). Because the forcing from CO₂ is approximately a logarithmic function of atmospheric CO₂ concentration each doubling of CO₂ produces approximately the same equilibrium warming. See Knutti & Hegerl (2008) for a review of equilibrium climate sensitivity.

(2) The experiment protocol followed in the manuscript follows the carbon cycle feedback model intercomparison project done in preparation for AR5 in with model results from CMIP5 (Arora et al. 2013). However, in numerous places in the manuscript it is stated that the experiment is following the C⁴MIP protocol. C⁴MIP used emissions driven simulations under the SRES A2 emissions scenario (Friedlingstein et al. 2006). Confusions between the two generations of model intercomparison projects demonstrated how little of the literature the authors appear to have read.

(3) The authors provide no sensible rationale as to why conducting a pseudo-one-percent experiment at LGM initiation conditions provides any new understanding of carbon cycle feedbacks in the Earth system. From the LGM we generally want to better understand how physical and biogeochemical feedbacks combined to magnify a tiny change in the distribution of sunlight into the glacial-interglacial cycles. From the pre-industrial we are usually concerned ultimately with projecting future climate change, even in idealized experiments designed to better constrain Earth system parameters. The results of the experiments document in the manuscript are obvious a-priori given the logarithmic forcing from CO₂, and the reduced state of the terrestrial biosphere at the LGM.

Specific Concerns:

The English language is very poor in much of the manuscript. I am not systematically going to document every example but if the authors are able to salvage something publishable from these experiments please ask a native speaker read over the manuscript before re-submission.

Page 2 line 8: The sentence implies that climate sensitivity includes carbon cycle feedbacks. It does not. Climate sensitivity is measured relative to a doubling of atmospheric CO₂ and the atmosphere does not care where the CO₂ originated.

Page 2 line 29: please write out and explain the names of experiments. These abbreviations are presumably experiment codes used internally at MPI.

Page 3 line 5 and many other places: The proper term is 'radiative effect' not 'radiation effect'. In vernacular English 'radiation' alone implies ionizing radiation.

Equation 1: Why is there a colon before the equals sign?

Page 4 line 4: Using upper and lower case 'c' for different variables is confusing and prone to error. Please use more easy to distinguish symbols.

Page 5 line 11 to 14: In the 1% experiment atmospheric CO₂ is increased at 1% a year leading to an exponential increase in CO₂ concentration. Here you have used a 1% experiment based on an initial concentration of 285 ppm for both initial states. This needs to be clearly explained.

Page 6 line 12: 1) Do not abbreviate 'archipelago'. 2) The region is geographically referred to either as Maritime Southeast Asia, or the Malay Archipelago. The Indonesian Archipelago includes only the islands that are part of the modern nation-state of Indonesia.

Figure 4: Why is soil water availability the only other parameter examined beyond SAT?

Page 11 line 9: Write out soil respiration instead of abbreviating to Rs.

References:

Arora, V. K., et al., 2013: Carbon-concentration and carbon-climate feedbacks in CMIP5 earth system models. *Journal of Climate*, 26 (15).

Friedlingstein, P., et al., 2006: Climate-carbon cycle feedback analysis: Results from the C4MIP model intercomparison. *Journal of Climate*, 19, 3337–3353.

Knutti, R. and G. C. Hegerl, 2008: The equilibrium sensitivity of the earth's temperature to radiation changes. *Nature Geoscience*, 1 (11), 735–743.

Planton, S., 2013: Annex III: Glossary. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.