

Interactive comment on “The Carbon Dioxide Removal Model Intercomparison Project (CDR-MIP): Rationale and experimental design” by David P. Keller et al.

B. Sanderson (Referee)

bsander@ucar.edu

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The submitted paper documents the experimental design for the CDRMIP suite of experiments, designed to explore model uncertainties in Earth System response to climate engineering through potential anthropogenic removal of carbon dioxide from the atmosphere. The MIP is well motivated, and the introduction does a good job of framing why such a MIP would be useful.

The paper should certainly be published, and I look forward to seeing the results of the MIP. I have some minor comments only, which I attach for the authors' consideration.

C1

Minor Comments:

1. The details of the experimental design need clarifying in places. For example, a number of the experiments require 'constant forcing' for non-CO₂ agents, but the authors do not explicitly state how to implement this. Should aerosol concentrations be held constant, or should emissions be held constant?
2. There is almost no consideration of internal climate variability, recommended ensemble size, and what role that might have. How many ensemble members are required for each of the experiments to assess the desired signal? If it is only 1, can the authors demonstrate that a single simulation can produce a sufficiently significant result to differentiate the structural differences between different models in the presence of climate noise?
3. It isn't clear how a proposed experiment `esm-ssp534-over` differs from the existing `C4MIP ssp534-over-bgc`. Could the authors make this more clear?
4. Could the authors expand on what processes would result in `yr2010co2` differing from `esm-hist-yr2010co2-control`, given that if compatible emissions are correctly diagnosed, they should be identical? The only case, to my mind, where this would not be true is if internally-generated climate noise was capable of changing the compatible emissions requirements. However, if this is the case, then the experimental design is insufficient - and an ensemble of `yr2010co2` simulations would be required in order to assess the central estimate for compatible emissions.
5. In `esm-hist-yr2010*`, what RCP/SSP should be used if 389ppm is not reached during the historical period?

Typos/presentational points:

Line 50: comma after climate
Line 118: Do any of the 2 degree scenarios (which have not already diverged from historical emissions) require no CO₂ removal? I'm not aware of them. Could they be cited?
Line 126: suggest "are not yet a commercial product"

C2

Line 395: This paragraph seems to imply that a GCM can inform policy which differs only in terms of the relative sizes of positive and negative fluxes which make up a net anthropogenic flux. This seems to be true only for a subset of CDR approaches where there are long term consequences of removal for future fluxes (e.g. reforestation), but not really for direct air capture. Perhaps this could be clarified Line 464: Suggest using a word other than "control" here, which is almost universally interpreted as a constant forcing simulations in other CMIP6 MIPs. Line 971: Is esm-535-over-ext a typo?

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