

Geosci. Model Dev. Discuss., referee comment RC2 https://doi.org/10.5194/gmd-2021-79-RC2, 2021 © Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.

Review of MCE v1.2 by Junichi Tsutsui

Christopher Smith (Referee)

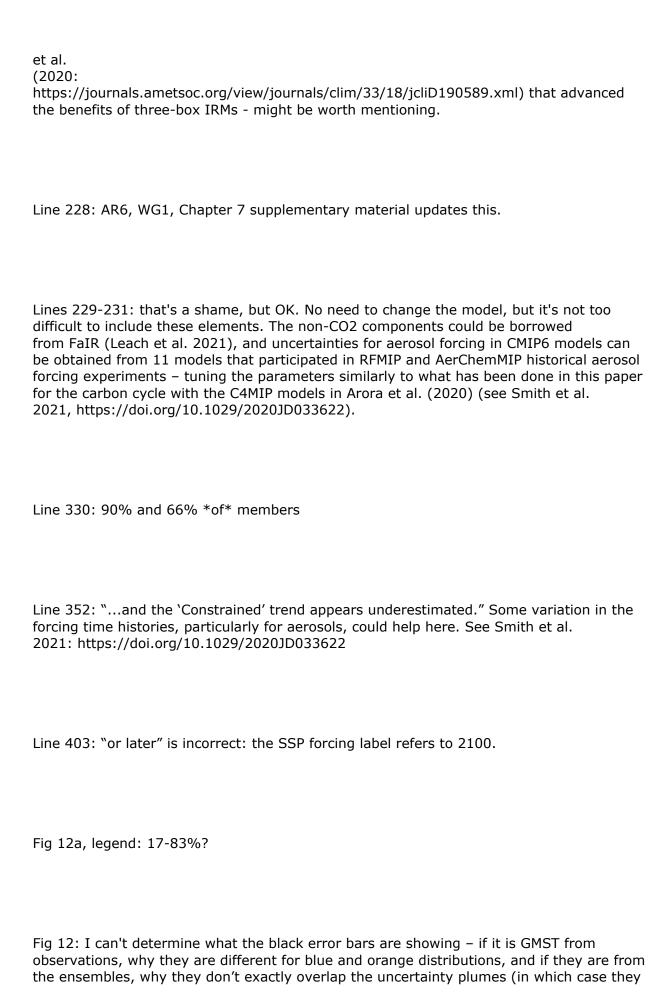
Referee comment on "Minimal CMIP Emulator (MCE v1.2): a new simplified method for probabilistic climate projections" by Junichi Tsutsui, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-79-RC2, 2021

This paper uses a Bayesian method to produce constrained projections of future warming in a three time-constant impulse response climate model (the Minimal CMIP Emulator, MCE v1.2). I find the level of detail given to be sufficient and the model description technically sound. The carbon cycle dynamics are impressive. The model is run in configurations that both emulate CMIP6 model behavior (blue lines and in section 3) and a "constrained" ensemble set (orange) that is constrained to ranges of key climate variables that are discussed in Nicholls et al. (2021).

My only major comment is not on the model itself but in the example application. The low projections of the constrained ECS and warming – assuming the ranges of Nicholls et al. (2021) which used the Sherwood et al. (2020) ECS assessment – are possibly too low. Sherwood et al. (2020) gives an ECS very likely (interpreted as 90% probability) range of 2.3 - 4.7 K, whereas the constrained distribution (I'm reading off figure 8 d) has a 90% range of less than 3.5 K. The implications of this are seen clearly in Figure 12: compare AR6 projections in Chapter 4 of that report (for SSP1-2.6, which is a "well-below 2C" rather than a "1.5C consistent" scenario) and assessment of present-day temperature in Chapter 2. The "constrained" range seems over-constrained (compare projections for SSP1-2.6 in AR6). Can you really have this much confidence in the future warming? I would just like some additional explanation as to why the model seems to provide such low constrained estimates of future warming (and whether alternative constraints would show something different). Such a discussion is important, if the aim for this model is to be used by the climate change mitigation community.

Specific minor comments:





would be superfluous anyway).
Lines 446-450: can you clarify whether the CO2 forcing expression is only valid in the 1x to 4x range?
Line 460: overwrapping > overlapping
Lines 479-480: Actually, there is no correlation between the strength of aerosol cooling and CO2 warming in CMIP6. See Smith et al. (2020: https://acp.copernicus.org/articles/20/9591/2020/acp-20-9591-2020.html, figure 9, and I also made this Twitter thread showing the difference compared to the Meehl paper step-by-step: https://twitter.com/chrisroadmap/status/1297798254789263360)
Line 491: "cited with" probably not the correct word choice here. "Driven by"?
Line 517: "human-induced warming is similar" also found to be true in AR6 (sorry, I know you submitted this paper before AR6 became publicly available, and I was heavily involved the report so I see AR6 statements everywhere).
Lines 529-533: Just a note to say I agree, and this actually was considered in the emulator runs for AR6. A long (2250 year) pre-industrial time series of volcanic forcing was used before the anthropogenic forcing starting in 1750 was assessed.