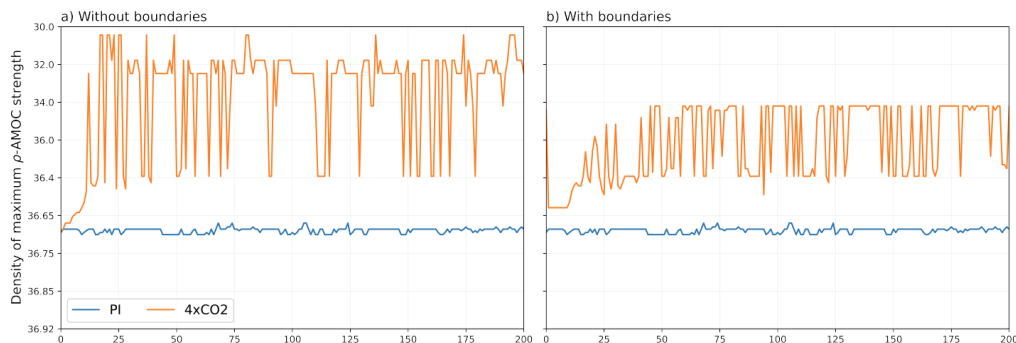


After reading the revised manuscript and the author's response to my previous concerns that clarify their methodology, I have two major concerns regarding the robustness of the methodology:

- 1) As explained in the response to reviewers, the author's method of diagnosing the density-based overturning streamfunction is only equivalent with the more conventional meridional transport-based method of diagnosing the density-based overturning if isopycnal drifts are taken into account. However, the authors provide zero evidence that the drift is negligible, either in the revised manuscript, in their response to my concern, or in the cited Sidorenko (2020) paper which establishes the methodology. Based on my experience performing similar calculations, I can confirm that mean isopycnal drifts are generally negligible contributions to piControl water mass budgets on multi-decadal timescales; in strongly-forced runs, however, I have found that the drift is a leading-order term in the water mass budget! For a manuscript focusing on the response of the density-based overturning to strong forcing, it is unacceptable to leave this key supporting evidence as "(not shown)".
- 2) Figure 2 appears to reveal a fatal flaw in the methodology. The fact that the density of the maximum ρ -AMOC strength oscillations between about $\sim 31 \text{ kg/m}^3$ and 36.4 kg/m^3 suggests to me that this metric is not robustly picking up the AMOC cell. While the authors seem to recognize this and have thus constrained the range of valid densities (as shown in their Figure 2b reproduced below) to a fixed range. [Aside: The main text states that the upper boundary is 35, whereas this figure shows it to be 34. Which is the correct one?] However, the maximum density still jumps around, just now within the artificially constrained range. **By visual inspection, it seems to me that these spurious multi-decadal jumps in the density of the ρ -AMOC map onto the multi-decadal oscillations in the strength of the ρ -AMOC streamfunction, which the authors argue is a key result of their paper, which is supposedly hidden by the z -AMOC streamfunction.**



I am concerned that these issues could constitute fatal flaws that compromise the key results of the manuscript. I would be willing to conduct a more thorough review after the authors have more substantially addressed these concerns.