Reviewer 2:

This is essentially a "show and tell" manuscript that presents the results of a series of experiments in a numerical ocean circulation model for the Arctic. These experiments include one at "eddy resolving" 1/12 degree resolution, and four at "eddy permitting" 1/4 degree resolution, the latter both with and without the Gent and McWilliams eddy parameterization (with two different eddy diffusivity caps), and also with the GEOMETRIC variant of Gent and McWilliams. Key metrics are compared also with observations.

On the one hand, the model results do provide some value in indicating how different elements of the hydrographic structure and circulation responds to the different representations of the eddies. On the other hand, there is no clear message that emerges, beyond those that are fairly obvious such as eddy kinetic energy is higher without GM or at higher resolution. For the more derived quantities, such as the overturning, some interesting variations are found between the experiments, but little is offered in the way of explanation.

The abstract summarizes rather nicely the manuscript as it stands: mostly a statement of the numerical experiments that have been performed, followed by two brief sentences stating how five properties (meridional overturning, barotropic circulation, northward transport, eddy fluxes, and temperature distribution in the Greenland Sea) change, the latter without any explanation.

In summary, I am struggling to recommend the manuscript, as it stands, for publication in Ocean Science. The manuscript reads more as a technical report rather than a scientific paper. Nevertheless, there are surely some useful results to be extracted from experiments, but the authors need to present a more thorough and rigorous analysis. It would probably help if the manuscript were framed in terms of specific hypotheses to be tested, if only to give more focus to the narrative and results.

I will refrain from providing detailed line-by-line comments on the text at this stage in view of the reservations raised above. However, I will note that there are a number typographical errors in the submitted manuscript.

We thank Reviewer 2 for the constructive comments. We agree that the previous version of the manuscript lacked a sufficiently clear hypothesis-driven structure and physical interpretation of several results, and that some model responses were difficult to interpret. We nevertheless believe that the study addresses an important topic and contains valuable results and analyses, which we hope are now more clearly presented in the revised manuscript. We have extensively revised the manuscript as outlined below:

- Added a hypothesis in the manuscript.
- Redesigned the ARCTIC025-lowGM experiment, which was the root of our unintuitive results. The capping of the K_{GM} field to a maximum of 75 $m^2 s^{-1}$ gave a very uneven reduction of the K_{GM} field with a very strong reduction in the North Atlantic where K_{GM} is high and a much weaker reduction in the Nordic Seas and Arctic Ocean where K_{GM} is low. In our new ARCTIC025-lowGM we instead scale the K_{GM} field (online) to 25% of its computed value. This gives a much more even reduction spatially and robust results with a response that lies in between the ARCTIC025-noGM and ARCTIC025-highGM experiments for all our metrics.

- Retuned the ARCTIC025-GEOM experiment by reducing the eddy efficiency parameter alpha=0.035 to get a reduced κ_{GM} field more in line with observations.
- Additional analysis of the barotopic gyre circulation. By introducing topostrophy and a baroclinic streamfunction we show how the vertically integrated thermal wind contribution changes the along isobath flow with GM parameterization.
- Additional analysis of the horizontally integrated heat budget over the Nordic Seas and Arctic Ocean comparing the different terms of the temperature evolution equation and particularly decomposing the advective contributions into mean and resolved/parameterized eddy temperature fluxes. We are also showing maps of resolved and parameterized eddy temperature flux divergence.

Per Pemberton,

On behalf of the other co-authors