

Interactive comment on “Multi-grid algorithm for passive tracer transport in NEMO ocean circulation model: a case study with NEMO OGCM (version 3.6)” by Clément Bricaud et al.

Anonymous Referee #1

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The manuscript presents a method for simultaneously applying spatial grids of multiple resolution to a popular ocean model for the purposes of reducing the computational cost of running complex biogeochemical modules. It estimates a factor 6.7 reduction in cost while achieving similar results to the single-grid high resolution version. Improving computational efficiency in models with large user groups and code bases is a priority in earth system modelling. This manuscript represents a substantial contribution to the science that is within the scope of GMD. The authors use valid methods to assess their model at a variety of spatial scales and provide sensitivity tests and examples to demonstrate their decision-making. Results are presented clearly and appropriately. Model code and other necessary scripts are provided with instructions.

Specific comments:

Climate is mentioned a couple of times in the manuscript, but what is demonstrated in this study is that a very slow model can be made faster (but, relative to e.g. EMICS, it is still very slow). The general motivation of making a model faster is clearly laid out in the Introduction, but even with the demonstrated improvement in runtime, as a reader I am left with uncertainty exactly what is gained with a 3X faster NEMO+PISCES. Some discussion of this in Sections 6 or 7 could help to clarify e.g. 1) does this improved runtime move NEMO+PISCES into a new category of earth system models? 2) what new kinds of applications are made possible by the improved runtime?

Simulations of 1 year are compared, but how close is the model to steady-state after only 1 year if the model is started from rest? A statement regarding why 1 year of simulation is selected for the comparison would be informative.

Some of the language needs revisiting, please see below.

Technical corrections:

P1L4: “to compute” should be “the computation of” P1L7: “allows to reduce” should be “reduces” P1L8: “tracers” P1L10, P1L11: “factor of 3”, “factor of 7” P1L13: “Propositions for further reducing this cost are discussed.” P2L31: run a spell-check for “operationnal” and “pannel” P2L34: “ecosystems” P2L45: “and is used in the” P2L47: This sentence is confusing. I suggest “The concept of effective resolution of physical ocean models provides a theoretical justification. . .” P3L50: “observation” P3L53: “experiments”, “difference” P3L54: “with the velocity field. . .has been. . .” P3L65: “in particular detail” P3L69: “grid in which” P3L72: “by the hydrodynamical” P4L98: “consists of” P4L101: “that will be discussed” P6L127: “surface area” P6L135: remove “autoref” P7L137: “of the multi-grid. . . consists of defining. . .” P9L167: “very sensitive to” P9L170: “such a method” P10L181: “using the multi-grid” P10L186: “use the domain” P12L224: “Throughflow” P12L225: “close to” P13L251: remove “grid” before “multi-grid” P13L253: remove “subsection” P15: please make the x and y val-

ues larger in Fig.5 b,c,d P15: please explain in the text why HRCRS is missing from Fig.5 b,c,d at the smaller spatial scales. For example, it appears both LR and HR can simulate low KE but HRCRS cannot. P16L290: remove “subsection” P16L293: remove “appendix” P17L310: “Despite the degraded spatial resolution operating on the velocities...” P17L311: remove extra “the” P17L316: “responsible for...passive tracer...” P17L317: “...but it might be computed on...” Although, as I understand the vertical diffusion coefficient is calculated on HR and coarsened using the several methods tested. A better phrasing might be: “and coarsened to the HRCRS grid” P18L320: remove extra “section” P18L327: “results more comparable to LR” P18L329: “skill” P18L335: “extends” P18L338: “...we assess the...at simulating the...the Ross...” P19L344: “solutions...performances than the...” P19L347: “Figure 9 show...HRCRS solution...” P19L351: “...the convection...” P20L362: “caused by” P20L363: “except in the area” P22L376: “...only with large...” P23L381: “the coarsened grid” Table 4: “with/without” should be “without/with”. What are the time units? P23L384 and Table 4 caption: Do you mean row? P23L386: “allows us to reduce” P23L392: remove extra “table” P23L395: “than the ocean/sea...” Table 5: “without versus with” P24L399: “their” should be “there” P24L402: “both grids share” Figure 13: “Outer” P25L411: “perspective” should be “extension”; “in its present form” P25L421: “which resolution” should be “whose resolution” P25L422: “allow the switch” P26L435: “...the reduction of elapsed time might be substantial...” (An estimate has been provided but not proven) P26L436: “case of comprehensive”; “allows us to reduce...” P26L438: “for further improving the performance” P26L439: “allow us to increase” P26L441: “even closer to” P27L458: “configurations” P27L467: “configuration”...“too noisy” P27L468: “of the tracer” P27L471: “in terms of the ” P28L478: “development”

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Discussion paper

