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Interactive comment on "How to use mixed precision in Ocean Models" *by* Oriol Tintó Prims et al.

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This paper is summarising a significant amount of work and provides several important contributions: it automates the introduction of a reduce precision emulator into a complex ocean model; it presents a method to optimise numerical precision automatically within such a model; it provides a rough estimation of memory savings if precision is reduced. The results are very relevant for GMD and the paper should be published. However, a revision following the comments below may improve the paper.

Major comments:

- There is one weakness of the presentation at the moment: Results for model simulations that are using the reduced precision configuration are not presented. If these

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are not shown, the reader will assume that the results are not so great but I think that this is actually not the case. Can you add some figures showing results when using the reduced precision configurations? E.g. mean fields for long term simulations and differences for short term simulations in comparison to differences that are caused by a change of the timestep?

- The English should be revised and improved throughout the paper (see some detailed comments below but there are more problems in the text).

Minor comments:

- One of the main problems for a precision reduction in ocean models is that conservation laws may get violated (mass and tracers). Can you comment on that? Or quantify mass loss/gain when running the reduced precision configurations?

- The constraints that come in via the exponent are not very well discussed.

- You may want to cite this paper: Düben, P. D., A. Subramanian, A. Dawson, and T. N. Palmer (2017), A study of reduced numerical precision to make superparameterization more competitive using a hardware emulator in the OpenIFS model, J. Adv. Model. Earth Syst., 9, 566–584, doi:10.1002/2016MS000862. It performs a precision analysis per parameter for the CRM used in superparametrisation similar to the one performed in this paper. It is also arguing that the parameter uncertainty that is found via an automated precision analysis could be used to develop stochastic parametrisation schemes. This may also add to an interesting discussion in this paper.?

- Page 4, second paragraph, "The objective..." This paragraph is difficult to understand and you may want to revise this. It may be easier to explain this with an example.

- Page 4 l31: "any information" is too strong.

- Page 5 l5: "uncertainty in the model inputs" but also model error.

- Page 8: ll 12-22 are very difficult to understand.

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- Page 10: I do not understand IQR and how it is used.

- Figure 1: Why do you not present the results for the tight evaluation? The light cray is not visible in my printout.

- For NEMO: Maybe I have missed this information: Do you state how many of the variables are actually used and how many are not used in standard simulations? You should also state the accuracy score when you run simulations with the combined precision reductions for the tight and loose precision configuration.

- Page 15: "AD and TL should be better targets" 4DVar experts tend to disagree with this statement since the forward TL and the backward AD need to fit to each other to guarantee convergence of the assimilation. Reduced precision can destroy this. You may want to discuss this less optimistically.

- Page 16 l12: Can you state what the "single variable" is?

- Page 16 l14: "80.7%" of the variables: Is this in amount of variable declarations or the amount of bits stored in memory? (This is probably stated somewhere but I could not find it easily).

Language:

Abstract: ll 13-15: "have the potential" should be revised. This part of the text is difficult to understand.

- Page 4 l33: "were accurate resulted in an inaccurate set when combined" should be rephrased.

- Page 4 l3: "for sure consider that" should be rephrased.

- Page 7 l27: "potential error" should be rephrased.

- Page 8 l3: "real arithmetic" -> "real number arithmetic"

- Page 8 l26: "a target reduced precision single-precision" should be rephrased.

- Page 8 l27: "analysis" -> "analyses"
- Page 9 l4: "the biogeochemistry" -> "biogeochemistry"
- Page 9 l9: "a 20%" -> "20%"
- Page 9 l10: "needs to be something that does not" -> "cannot"
- Page 9 l29: "netCDF, the used by" should be rephrased.
- Page 12 l3: "that will be creating the simulaton scripts" should be rephrased.
- Page 12 l26L "and until the level 4 we do" is unclear.
- Figure 1: "having in the account" should be rephrased.
- Page 13 l6: "In the other hand" -> "On the other hand"
- Table 3: "that them represent" should be rephrased.
- Page 15: "made that the same tool" should be rephrased.
- Table 4: "that them represent" -> "that they represent". "an 80.7%" -> "80.7%"
- Page 16 l3: "mod_ocean.f90" is a bit out of context.
- Page 17 l2: "looking at the two experiences" should be rephrased.
- Page 17 l16: "can led to" -> "can lead to"
- Page 18 l1: "the the"
- Page 19: "the set has is"

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