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Interactive comment on "Assessment of the Finite VolumE Sea Ice Ocean Model (FESOM2.0), Part I: Description of selected key model elements and comparison to its predecessor version" *by* Patrick Scholz et al.

Patrick Scholz et al.

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Interactive comment on "Assessment of the Finite VolumE Sea Ice Ocean Model (FESOM2.0), Part I: Description of selected key model elements and comparison to its predecessor version" by Patrick Scholz et al.

Mark Petersen (Referee #1)

The paper by Scholz and co-authors is a careful description of FESOM2.0, including the vertical coordinate, free surface formulation, parameterizations, and comparisons

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to FESOM 1.4. These details are very useful to fellow ocean modelers, like me, because it provides both documentation of the model and, more importantly, the developers' reasoning behind those choices. The scientific significance, quality, reproducibility, and presentation are all high, so I am recommending publication by GMD. English writing is good, but I've included some corrections below. Plots are well done and nicely labelled.

We thank Mark Petersen for his efforts and constructive comments. We tried to thoroughly include all of his comments or answer his concerns. Further, we have to add that some months after the submission of the manuscript we discovered a bug in the code of FESOM2.0 that only affected the zlevel and zstar part of the model. This bug made it necessary to redo only these runs. That means that the figures 2, 3, 4, and 5 are new, which also required to rewrite their descriptive part in section 3.1.

I am very impressed with the performance improvements in FESOM 2.0, and excited to see an unstructured-mesh model that has throughput that is comparable to structured models. Thank you for the explanation of the reduced scalability of FESOM 2.0. This can typically be described by a certain minimum 'vertices per core', below which communication dominates computation. For your Fig 19, it looks like the full model has good scaling to 0.64M/2304cores = 270 vertices/core. Please comment in the text if that rule of thumb holds across meshes, i.e. we expect that meshes with more vertices can scale well to a higher number of cores.

–> We added that information to the manuscript.

–> ...As a general rule of thumb, that holds across a variety of meshes and High Performance Computers (HPC), it revealedÂă that FESOM2.0 scales linearly until around 400 to 300 vertices per core, below that the scalability starts to slowly deviate from the linear behavior (Koldunov et al., 2019). . . .

Fig 19: This figure can be greatly improved. I much prefer simulated years per day on the left, which is a simple calculation, but allows for comparison across models at

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a glance. Your current unit does not tell me the throughput. Number labels on left should be standard log intervals (0.1, 1, 10) and not 5 digits long. I prefer to have light grid lines behind to follow data points across. It's also very useful to put a dashed line behind all of the data lines to show perfect scaling.

–> We improved Fig. 19 as the reviewer suggested.

Line 424: A diagram of the tetrahedral elements and prismatic elements would be very helpful, and show at a glance what you are explaining with text here. You could show the array indexing for each version below the sketch.

–> We added an additional supplementary figure Suppl. 4 to highlight the indexing difference between prismatic and tetrahedral elements

Fig 20 is very nice, and an artistic representation of your mesh development. I know this is diagrammatic, but the dark colors make the text impossible to read. I would lighten up the colors. Simplify the text in your circles – remove the tilde, and use 2 sig digits only, like 87K, 910K, 3.1M, 16M etc. Put only a few words below, like "1 km Arctic".

–> We improved Fig.20 as suggested by the reviewer.

Small items: line and text correction

line 27: have been -> were → changed in manuscript

line 28: taking the -> requiring → changed in manuscript

line 35: development of new generation ocean -> development of this new generation of ocean → changed in manuscript

line 45: In the recent -> In recent → changed in manuscript

line 45: came to the focus -> came to be the focus → changed in manuscript

line 65: ALE; Ringer -> Please change to Petersen 2015, which is where ALE coordi-

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nate is presented → changed in manuscript

line 67: allows to utilize plenty of -> allows a choice of → changed in manuscript

line 67: like -> such as. (or including) → changed in manuscript

line 73: part of the progress made so far. -> the progress to date → changed in manuscript

line 80: medium-sized (add hyphen) → changed in manuscript

line 105: a medium-sized → changed in manuscript

line 138: Peterson -> Petersen (-en is correct) → changed in manuscript

line 154: Since in -> With the → changed in manuscript

line 154: than in zstar case it -> than in the zstar case, so it → changed in manuscript

line 157: onto -> on → changed in manuscript

line 165: linfs both, -> linfs, both → changed in manuscript

line 181: stronger -> strongly → changed in manuscript

line 254: 'gradually switched off': Please specify if you use a ramp or tanh, what lower resolution is where GM is effectively off, and if Bolus/Redi are treated the same way. → changed in manuscript

Line 265: within same -> within the same → changed in manuscript

line 269: especially seen -> particularly visible → changed in manuscript

line 306: Align -> The behavior aligns → changed in manuscript

line 371: ref is bold → changed in manuscript

line 433: configurations -> configuration → changed in manuscript

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line 510: Part of ... -> These differences result in part from → changed in manuscript

line 559: in an own -> in a separate → changed in manuscript

line 559: can be -> may include → changed in manuscript

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2018-329/gmd-2018-329-AC1-supplement.pdf

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Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-329, 2019.

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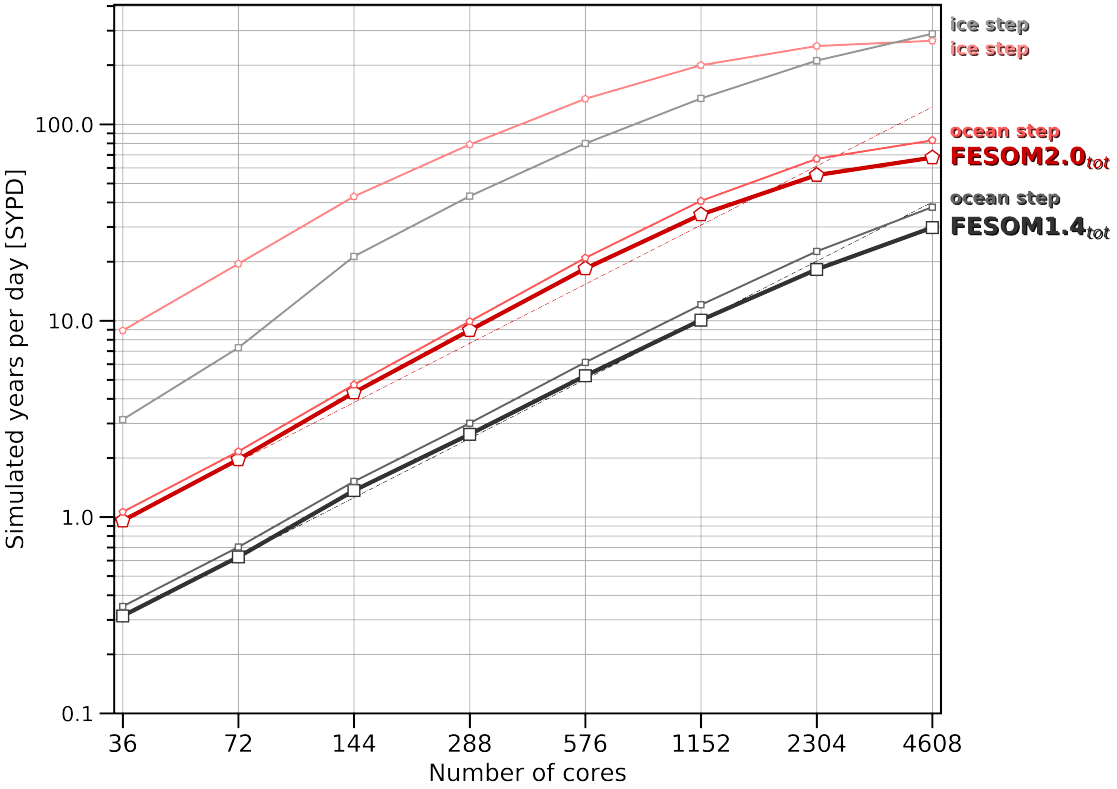

Fig. 1. New Fig. 19

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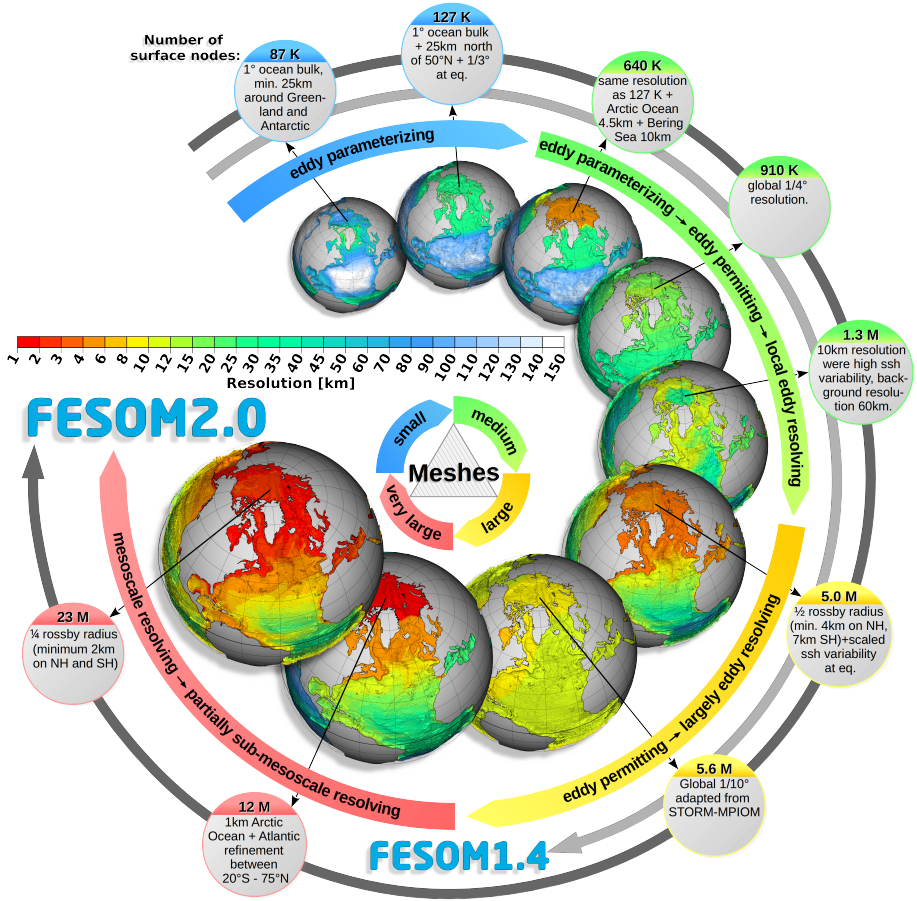

Fig. 2. New Fig. 20

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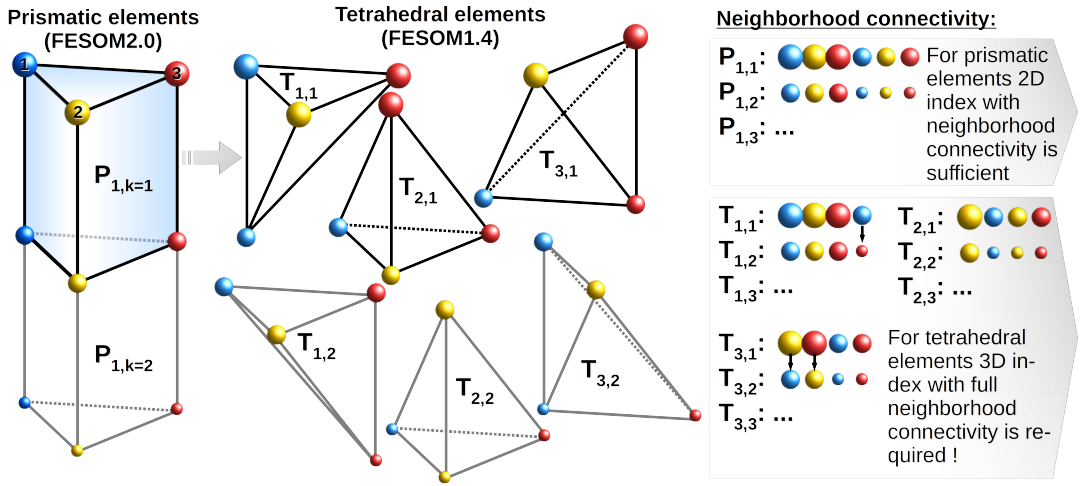

Fig. 3. New Suppl. 4

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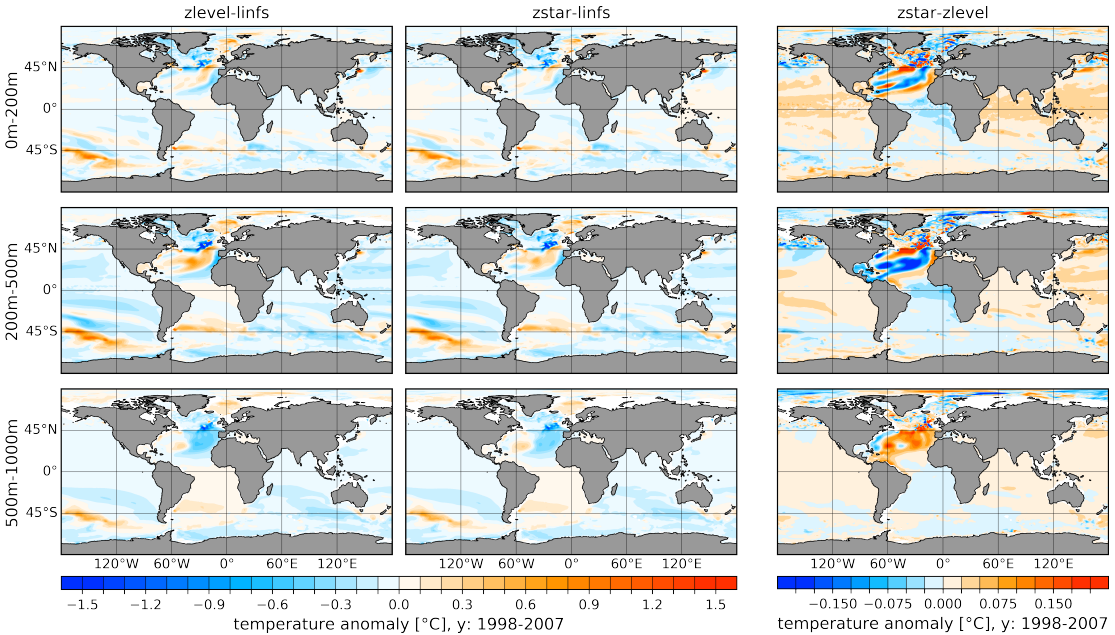

Fig. 4. New Fig. 2

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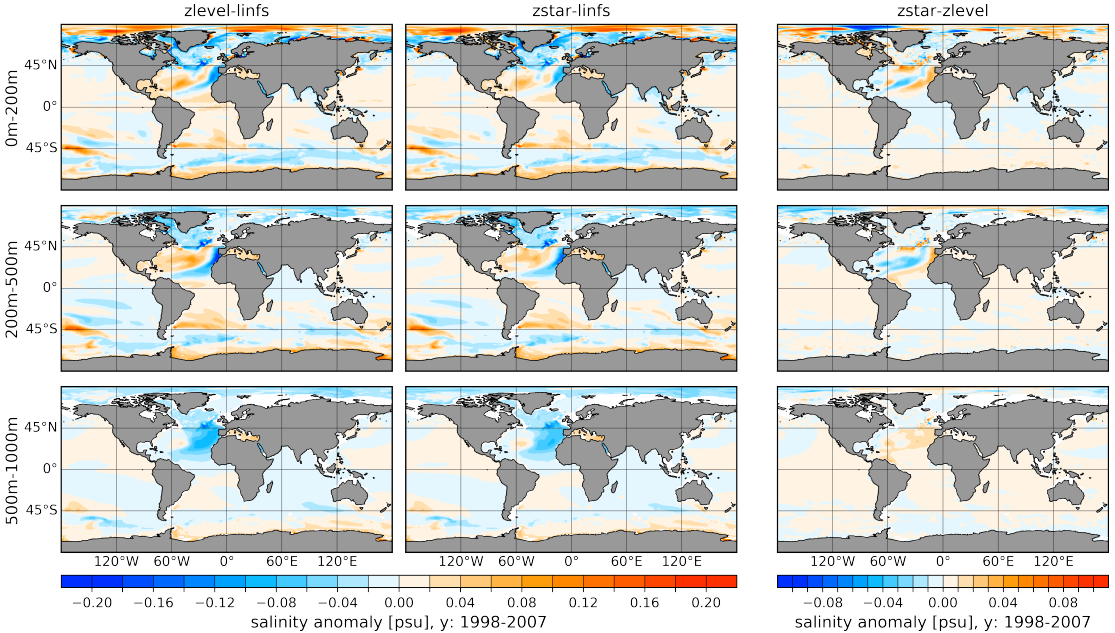

Fig. 5. New Fig. 3

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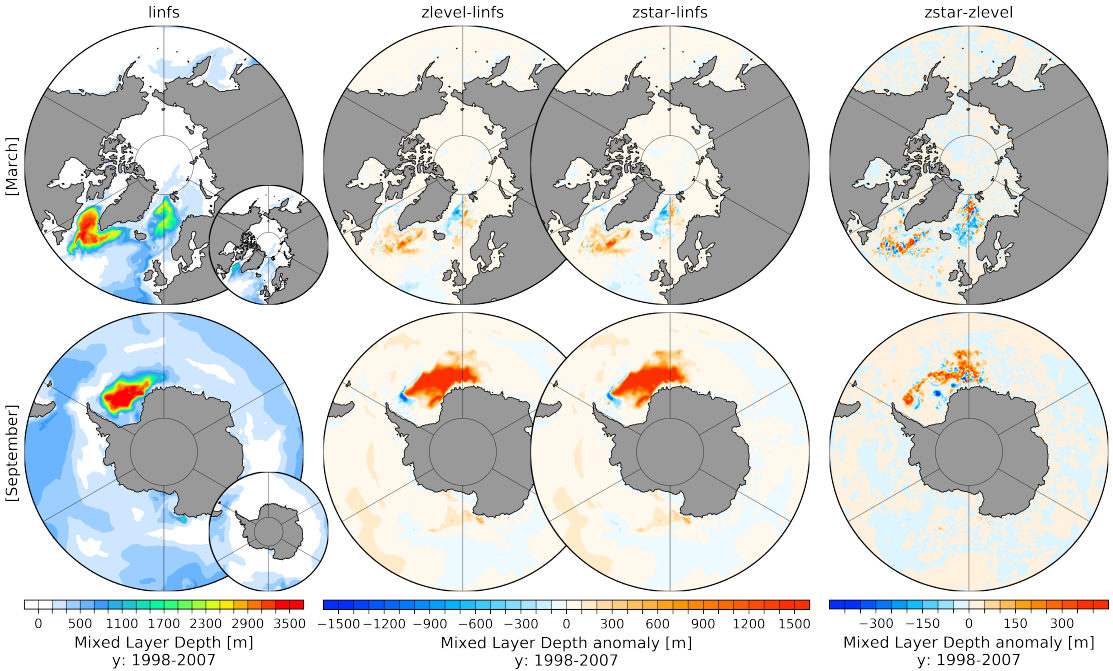

Fig. 6. New Fig. 4

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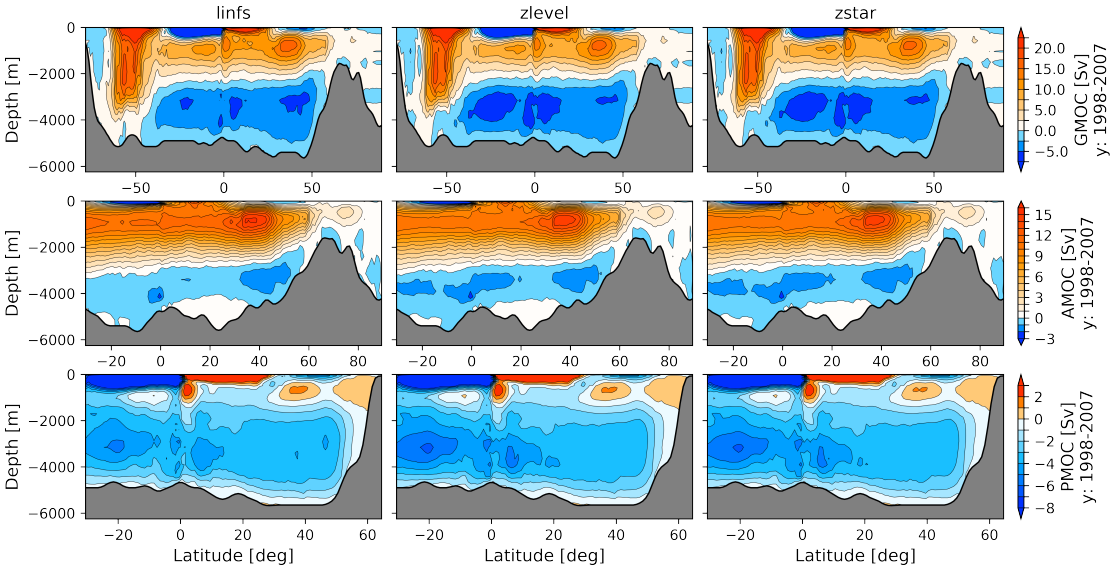

Fig. 7. New Fig. 5

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