Response to reviewer 2

We first want to thank you for paying very careful attention and spending time to review our work; we carefully cope with your remarks and advices that greatly help to improve our manuscript. We hope these modifications make the manuscript significantly clearer and thus worth publishing.

This manuscript describes the implementation of 2-way nesting into the 3D ocean model MARS3D using the AGRIF software package. The model is then applied to several domains to demonstrate its utility, specifically around the issue of residence times in coastal waters.

Major points:

The manuscript is generally fairly well written (but with frequent grammatical errors), although it does seem to be conflicted about its focus. It's hard to discern what this is; is it to introduce the implementation of AGRIF into another ocean code, characterise the physics of the Bay of Brest region or further demonstrate the benefits of 2-way nesting. If the former two, then I think the paper falls short. If the latter, then this is not entirely new. The discussion section reads as if the object of the paper is indeed this improvement over 1-way nesting. However, the configuration chosen to make these comparisons is hardly unique, and the 1-way configuration to which the 2-way is compared seems set up to fail. Similar objectives of resolution placement and computational cost may be achieved by exercising the curvilinear capabilities of 1-way grid, for example, a polar-style curvilinear application may similarly achieve high resolution at the coast but decrease resolution at the seaward open boundaries. Such an application may provide equivalent dynamical advantages to the 2-way approach. Also, compared to the continuous resolution transition across scales afforded by unstructured models, the two-way approach presents a rather brutal interface that requires work (e.g., sponge zones, restriction operators) to produce a viable solution. In this sense the unstructured approach is a more elegant and dynamically consistent approach. If benefits of 2-way nesting are the focus, it would be interesting to compare to, or at least consider, a tailored curvilinear grid or unstructured approach at the same resolution in the target area. My guess is the solutions would be similar in all cases if grid/meshes are carefully constructed, so benefits would come down to throughput. This would make for an interesting paper, but probably not within scope of what's tractable here. An important advantage of 1-way nesting is that once the open boundary files have been generated, then they can be re-used at no cost, whereas for 2-way nesting the parent must be also run every time the child is optimised, or an additional experiment performed. Since the child obviously runs faster than the parent+child, in terms of overall throughput this may be a more efficient system if many runs of the child are required. The re-use of child OBC conditions probably deserves consideration. Regardless, if comparative 1/2-way approaches are considered, then a more rigorous consideration of throughput could be included alongside dynamical benefits, and optimized 1-way configurations should be explored.

This first major point is quite exhaustive and a bit hard to address. Nevertheless, we try to argument here below and accounted for most of the points within the manuscript itself.
The fact that you found hard to discern what are the main points of this manuscript reveals that we must re-organize it. The major topic is mostly the implementation of AGRIF refinement capability in the MARS3D model in a two-way mode: after a description of the method, we give two examples of use that illustrate the built-in capability. We deeply reorganize the text in order this point of view is more straightforwardly catchable by the reader. In that sense we agree with the need of clarification pointed out in your review. We try to avoid confusion induced by comparing one way and two-way approach that is clearly not our main goal here.
"Is that very new or not" is a point that is let to the discretion to the reviewer. Our point of view is that it is worth to illustrate an implementation of AGRIF in a split implicit model (MARS) which raises different question with respect to the implementation in a split explicit solver (e.g., ROMS). It is also for us a step forward as long as what was described in the literature was only one-way (Muller et al., 2009) and partially two-way (Dufois et al., 2014). Since then, many improvements were performed that are now described in further details in the scope of the paper.
We also take advantage of your point of view to position our problem in a broader perspective of the community of ocean modeler that have to cope with local / targeted refinement. We enriched the introduction with more references that described a large span of approaches to reach this goal. But as you pointed it out, it is largely beyond the scope of this study to compare or cross-evaluate different approaches. Your arguments are very valuable, there is no doubt and even we do agree with you:

- We mention and quote some alternative approaches for the local refinement would it be structured (Diaz et al., 2020; Rétif et al., 2014… among many others) or unstructured (Comblen et al., 2010; Guerin et al., 2016; Qi et al., 2018). We also pointed out that the design of curvilinear structured orthogonal or even non orthogonal curvilinear structured grid (Grasso et al., 2018) might be a great deal of work with a lack of flexibility. Without an efficient grid mesh generator, the nesting proposed here keeps it simple for the end-user. Considering unstructured grid, it is recalled it induces a significant computational cost or constrain required by the finest grid cells to not spill over the entire grid. Yet the reviewer #1 mentioned the existence of spherical multiple-cell grid model developed by Li (2021) which circumvents this constraint.
- We remind the argument in favor of a one-way approach in case one has to perform repeated experiments for tuning purpose or whatever. The comparison made between one-way and two-way nesting methods are based on recent configurations with the same geographic extent and recently used for environmental studies (Cadier et al., 2017; Gangnery et al., 2019; Petton et al., 2020). So, it is still relevant to compare them with the two-way nesting approach. However, you are correct to mention the possibility of using curvilinear grid in order to bypass numerical issues at open boundaries. The one-way nesting stays for now what is typically performed in applications with our partners. The use of AGRIF approach induced a significant computation cost due to the inegreation over the whole grid hierarchy. You are absolutely right that the re-use of child OBC computed once for good is a lighter solution in case several runs are performed with different parametrizations or different environmental assumptions. However, this is typically dependent of the final objective. The regional configuration presented was mainly used to produce a hindcast over 10

years. It is still running in operational mode. Finally, the two-way nesting is a solution with MARS3D to insure a conservative approach (biological tracer, connectivity study…) over large geographic area at minimum cost.
Nevertheless, our point is just to promote one among many other relevant solutions keeping in mind that none of these fulfill all the desired requirements. So, we mention in the new release of the paper some of your arguments.
Last, we point out that the physics characterization of the Bay of Brest is not within the scope of this study. It is a case study where the two-way nesting is not necessary for the hydrodynamics inside the bay whereas it is compulsory to obtain a valid time renewal indicator with mass conservation update and forcing between mother and child grid.

The system characterisation of the region comprises validation against tidal observations and T/S. The flushing time is then computed (using 1 and 2-way) for the Bay of Brest. Although the paper considers several flushing metrics, a variation of the non-stationary method (e.g., Tartinville et al., 1997) is used. The authors speculate on the physics responsible for the distribution of these flushing times, but I'm not sure this is a significant addition to previous studies of the region cited in Section 2.3.1
As quoted previously, our goal was not to focus on the system characterization but rather to illustrate pros of the refinement methodology (implemented here with two levels of grids) that copes with the tidal prism oscillations more accurately. Such time scale indicator was not accurately estimated for this bay at this horizontal resolution (Le Pape and Menesguen, 1997; Pommepuy et al., 1979). Using the two-way method is a new way to get validated and spatially detailed flushing metrics for such control volume. The foremost finding obtained is the overestimation of the renewal capacity of the bay when using one-way nesting compared to two-way nesting. The structure distribution is explained by the integration of neap-spring tidal cycle and the runoff intensity. The indicator reliability was accessed using the same model with a smaller control volume; in that case both one-way and two-way nesting estimate the same renewal time.

The application of 2-way nesting is not new, neither is the implementation of AGRIF in coastal modes. In Section 2.2, it seems that AGRIF has previously been included in MARS3D (e.g., Dufois et al), so it seems that the MARS3D+AGRIF combination is not new either (?). One of the challenges of using AGRIF to orchestrate 2-way nesting previously has been the issue of coupling at the barotropic level. Since all ocean models are either mode split, or semi-implicit (as is this one), then to maintain stability and accuracy in 2-way systems it is generally required that information be exchanged between coarse and fine grids at every barotropic step in the case of the former and every iteration of the implicit solver in the latter. I'm unsure if AGRIF has been applied to semi-implicit models, as I believe the implementations in NEMO, ROMS and HYCOM use a mode-split approach. This potentially is a point of difference in this study that should be exploited, requiring better articulation of coupling at the barotropic level.
You are perfectly informed and our purpose is exactly what you pointed out: the originality of the implementation described (now in further details) in the paper is the fact that barotropic solver and the barotropic / baroclinic coupling is very different in MARS3D than in the three other models quoted which all have a split explicit free surface. What is reported here is some steps ahead of what have been used earlier. These past implementations solely assured the mass conservation with one-way nesting (Muller et al., 2009) and in two-way nesting only for the tracers (Dufois et al., 2014). The MARS3D code gathers now numerous developments for fully operational two-way nesting, and the implementation of AGRIF in a split semi-implicit surface model was never performed to our knowledge. We think it is worth presenting it as long as the Alternate Direction Implicit (ADI *ie* semi-implicit) solver used in MARS3D is quite popular among coastal modelling community (Chakraborty et al., 2021; De Goede, 2020; Parsapour-Moghaddam and Rennie, 2017) concerning model as widely spread as Delft3D or Mike21. Considering this remark, the article was restructured to better identify what is new in MARS3D model, AGRIF library and the two-ways nesting technique implementation. The Sect. 2 is now devoted to innovative developments with reference to previously published studies.

Minor points:

P1. L15. 'institute for the exploitation', do you mean 'exploration'?
No, exploitation is still the right acronym for our institute created in 1984.

P1, L16. 'preserves some essential principles', suggest replace 'principles' with 'properties'.
Performed.

P1, L16. 'constant preserving', do you mean preserving constancy condition, monotonic, positive definite? What are the 'induced constraints'?
We meant "constancy condition" but we replaced it with "mass and momentum conservations". The induced constraints are mainly the need of bathymetric coherence and the increase of computation cost.

P1, L22. 'the paper intends at comparing', suggest changing to 'intends to compare'.
Performed.

P1, L23. 'how MARS3D-AGRIF tool', suggest 'how the MARS3D-AGRIF tool'. 'efficient way significantly', suggest 'efficient way to significantly'.
Performed.

P1, L24. 'bring it biological issues'. What does this mean?
We replace the sentence by "unravel ecological challenges".

P1, L28. ‘and surely for a long time’, suggest changing to ‘for a long time’.
Done.

P1, L31. ‘grid on key-locations’, suggest ‘grid at key locations’. ‘region can varies’, suggest ‘region can vary’.
Done.

P2, L36. ‘solitary waves train’, suggest ‘solitary wave train’.
Performed.

P2, L38. ‘And then they’, suggest changing to ‘Then they’.
Performed.

P3, L70. ‘introduces shortly, suggest changing to ‘introduces briefly’.
Thank you for this suggestion, we delete those words as the Sect. 2 has been split in two. Sect. 2 is now dedicated to the innovative developments compare to previous published works. Sect 3 depicted both configurations and time scale indicator.

P3, L83. ‘allows to enhance the’, suggest ‘allows the enhancement of’.
Thank you for this suggestion, we remove this sentence to clarify this subsection to new developments in MARS3D V11.2.

P4, L98. Perhaps for completeness explicitly specify the function G.
Actually, it is explained just after the equations. It gathers the vertical average of all the remaining terms including the non-linear and the dissipation terms, the Coriolis force, the friction at the surface and the bottom.

P4, Equation 2. Perhaps some introduction of eqn. 2 is required to make known its purpose; is this simply an expansion of eqn 1? For what purpose – what are you trying to show here?
The system (2) is rigorously equivalent to the system (1). It is just a reassortment:

- For the sake of readability, we introduce $u^{n+1,*}$
- If we expand $u^{n+1,*}$ into the fourth equation of equations system (2), we get exactly the third equation of the equations system (1)
- If we gather the first term of the right hand side of the third equation of the equations system (2) ($-g\Delta t^2(1-\alpha)\frac{\partial}{\partial x}\left[h^n\frac{\partial \eta^{n+1}}{\partial x}\right]$) with the second one of the left hand side ($\Delta t\left[\frac{\partial}{\partial x}(h^n u^{n+1,*})\right]$) and expand $u^{n+1,*}$ we obtain $\Delta t\left[\frac{\partial}{\partial x}(h^n u^{n+1})\right]$ which is exactly the second term of the left hand side of the second equation of system (1)

This is worth to mention it as long as the system (1) leads to a global solver for a given (here) row that tight η^{n+1} and u^{n+1} in the unknown vector whereas the system (2) leads to one local solver (for u^{n+1}) and one global solver for the same given row which unknown vector is made solely of η^{n+1}: it is then twice smaller. It is an efficient way of saving MPI communication as long as the global communications between tiles are reduced for the barotropic solver by a factor of 2.

P4, L115. Perhaps a brief overview of this is required. Either include the full equations or reference Lazure and Dumas and make it clear the above refers to the semi-implicit method (as opposed to explicit mode-split).
We agree with you and we develop this section with previous refence and a clear mention to semi-implicit method.

P6, Eq 5 & 6. These could probably be made clearer by a more explicit formulation.
OK, we only partially addressed this remark as long as there is no clear in-between the full complex development and the formulation as it stood.

P6, L162. Do the iterative strategies used by Haley, Martin mean that 2-way nesting has been previously used in semi-implicit models? If so, this probably needs to be stated earlier.
According to our knowledge it is not the case. Nevertheless as long as this is not a crucial point in our purpose, we suppressed these references and this allusion for the sake of simplicity.

P7, L187-189. What about conservation for the fine grid using interpolated coarse grid variables? Is this interpolation conservative?
Yes, such as the update step, the interpolation is conservative. We add specific details about this important section.

P9, L265. What are the ‘classical open boundary conditions’? Sommerfeld radiation (which ones), Flather radiation, adaptive radiation, Dirichlet, upstream advection (characteristics)? The OBC used plays a key role in model accuracy and stability, and some further consideration here is probably warranted. These choices will likely impact the validation metrics in Section 3.2.
You are right, the term “classical” was definitely too obvious considering the wide range of possible schemes. We remove it and specify the scheme used clearly in the manuscript.

P10. L292-293. It’d be good to show the control domain on a diagram.
Thank you for this remark. The western boundary of the control domain was added with a dash line in the Fig. 6.

P10. L298. ‘tracer concentration equal to 0’. This is for inflow – what about outflow concentrations?
As the inflow concentration of water coming from the ocean are set to 0, the outflow concentrations are not taking into account. There is no zero gradient condition apply to the boundary of the model. This is only right for the larger model (250m Iroise mother

grid for two-way nesting; 50m Brest grid for one-way nesting). The back-and-forth flow through the control volume border is properly taking into account. We detail more this point.

P10. L299. 'between 95% and 1/e'. Is it 95%, or 1/e (which is ~36%)?
We need to clarify this point. The flushing lag t_0 represents the time decrease for the concentration to reach 95%. Then the local flushing time represents the time between this flushing lag (95%) and the time decrease up to $1/e$. On one point of the grid, the global flushing time is the addition of the flushing lag and the local flushing time. Removing the flushing lag is important especially in geographic complex areas. We re-order this paragraph to be clearer.

P11. L303. 'To get rid of the initial conditions', what does this mean? 'the 13 tracers' – what are the 13 tracers? Perhaps clarify.
Plus et al. (2009) demonstrated that the release time has an effect depending on the initial tide moment. Therefore, a release of 13 tracers that covers every hour for the tidal cycle is needed to get a more robust indicator. We delete the word "the" and added the above reference.

P12. L348. Change 'ODDYSEA' to 'ODYSSEA'.
Performed.

P13. L356. 'according to the chosen boundary scheme'. What is the boundary scheme? These details are important.
Yes, you are right. It's a prime interest in this study and we should have given more details about it. We specify explicitly which open boundary scheme was used for currents and tracers in the previous sections for the one-way nesting. As this paragraph concerns the impacts of offline interpolation, the chosen boundary scheme is not relevant here so we rephrase this sentence.

P13, L368. Change 'computational coast' to 'computational cost'.
Performed.

P14, L390. What about comparison to the low frequency component? This is a harder test for the model. The tidal component only really needs to be compared over a neap-spring cycle, whereas the low frequency component requires a much longer series.
Thank you for this suggestion. The PREVIMER tidal components atlas does not provide maps for low frequency waves such as Ssa, Mm or Mf. Any comparison would then be questionable. Though, the difference between one-way and two-way for theses waves are below one centimeter. It is the reason why we did not mention this detail.

P15, Table 4. I'm assuming the amplitude in cm is for the model, and the relative difference is the model-observation difference. If that's the case then some of the K1 metrics don't seem to line up (e.g. an observation of the 1-way amplitude overestimated by 9% doesn't seem commensurate with a 2-way amplitude of 8.8cm overestimated by 29%).
You are right for the quantities and the units; we modify the legend for more clarity. For the example chosen, both nesting methods overestimate the actual value of K1 wave which is 6.82cm. As you well spotted, it is hard to understand these differences without knowing the sign of the relative difference. We add it to the table consequently.

P15, Section 3.3. What are the specific improvements of 2-way nesting? Perhaps use this paragraph to better introduce Sections 3.3.1 and 3.3.2.
We actually reorganize the manuscript by presenting sequentially both realistic configurations. In this way, we hope the improvements of two-way nesting will be clearer for the reader.

P15, L429. At what locations do the Taylor diagrams correspond to? Perhaps mention the gauges in Fig 4 here.
You are right: the comparisons in the Taylor diagrams are related to the gauges presented in Fig. 3 and Fig. 6. We had a specific comment about this.

P16, L447. 'This could be explained by the nesting feedback that enables a more accurate temperature budget in the mother grid'. Perhaps if a high-resolution grid were designed with a polar curvilinear application that maintained high resolution at the coast but pushed the open boundaries further into the area occupied by the mother, then a similar result would be achieved to the 2-way approach. i.e., any difference may be a consequence of the configuration design due to shortcomings of the 1-way approach not being properly accounted for (in this case with open boundaries too close to the area of interest).
Yes, you are right. The shortcomings of the one-way approach are revealed due to the lack of simulated domain compared to the two-way nesting. A far larger grid (with extra computing time) or another kind of grid as you quoted (unstructured, polar curvilinear, …) would have been a fair comparison. However, it is largely beyond the scope of this study to compare or cross-evaluate. We highlight the fact that this one-way approach is not the finest one.

P16, Section 3.3.2. The Ushant front is stated to be due to tidal mixing. Table 4 indicates that, on balance, the 1-way approach has a better representation of the tidal height (although this is mainly due to K1, which appear to have some inconsistencies in their reporting). This comparison to sea level implies the barotropic currents (and hence tidal mixing) are similar (or better) for 1-way compared to 2-way models; i.e., the 2-way exchange of barotropic currents doesn't seem to improve tidal currents in the model interior over 1-way nesting. If this is the case, and resolution is the same in the 1 and 2-way Iroise zoom (500m), then why is the 1-way result worse in terms of the front? Some speculation around the dynamics causing this may benefit.
Not only the tidal mixing is responsible for the Ushant front but also the initial spatial distribution of temperature field (Brumer et al., 2020). The tide is indeed better represented with the one-way nesting because this model is forced with the SHOM CST-France model (112 harmonic components). Nevertheless, this upwind scheme used for tracers at open boundaries is not sufficient for the

heat exchange at an hour frequency. This crucial aspect needed to be better highlighted, as the simulated domain is not large enough to bypass this issue. As you mentioned earlier, a more adequate one-way nesting with polar curvilinear should have overcome it. We describe

P18, L494. 'initially the flushing lag'. What is the flushing lag's value?
We should have said "the initial flushing lag" as it represents the time decrease for the concentration to reach 95%. Here for the control volume, it ranges from few hours next to western border up to 7 days in the eastern part of the bay. We clarify the description of the time indicator and give the range of the flushing lag.

P18. L495. 'The same analysis….', is this analysis the Bay of Brest 50m model forced by the regional 250m model? Perhaps clarify.
Yes, as said in the manuscript, the same simulations are made with the one-way nesting configuration for each scenario. The Brest 50m model is run solely forced by the regional 250m model. We replace the sentence to clarify the approach.

P18, L498. 'The one-way nesting overestimates…', how do you know the 1-way is incorrect and the 2-way is the better estimate?
You are definitely entitled to ask which one is the better. The same approach was used with a far smaller control volume located only inside the bay. As the simulated domain is larger than the control volume, results were the same between nesting methods. We add a specific comment about this.

P18. L513. 'on behalf of various reasons', suggest changing to 'due to various reasons'.
Done.

P18, L515. 'AGRIF library as used for a split free surface ocean model'. Isn't the model semi-implicit rather than mode-split?
Yes, you are absolutely right. It is a mistake and we correct it.

P18, L517. 'requires to write and store the 3D forcing file', suggest 'writing and storage of 3D forcing files'.
Done.

P18, L518. 'grid are picked up.', suggest changing to 'grid are supplied'.
Done.

P19, L519. 'high frequency writings', suggest 'high frequency output'.
Done.

P19, L520. 'other kind of issues', suggest 'other kinds of issues'.
Done.

P19, L521. 'Despite there are many improvements to deal with that question', suggest 'Despite the many improvements to deal with this question,'.
Done.

P19, L523. 'the cost of long-term storage of massive data.' Only data on the open boundaries need be stored, which may not be that massive, even at high frequency. Also, storing data enables reuse for the child only, without having to run both the parent-child.
Yes, only the open boundaries of the child grid need to be stored in one-way nesting. It is the main actual solution used with MARS code but the interpolated OBC data on child grid at high frequency (sometimes 5 mins for keeping momentum and density coherence) could represent a large space. As mentioned earlier, the re-use of child OBC is a lighter solution if several runs are needed with different parametrizations or different environmental hypothesis. However, this is typically depending on the final objective. We add a specific statement concerning this point.

P19, L525. 'sketched' – what does this mean in this context? Perhaps rephrase.
We simplify the sentenced by saying "more flexibility than AGRIF provides".

P19, L526. '… by performing them online at each time step….'. This is true, but there is no possibility of re-use, which may be a disadvantage in some cases.
Yes, you are right, the time computation remains the main drawback of the two-way nesting. For testing numerical developments, the two-way nesting is not a straightforward process. It is more adapted to create hydrodynamic hindcast or to transport tracer along long geographic area with different horizontal resolutions. We discuss more about this drawback in the manuscript.

P19, L530. 'consists in the', suggest changing to 'consists of the'.
Ok

P19, L537. 'constraints prevent from gravity issues', suggest 'constraints prevent the gravity issues'.
Ok

P19, L538. 'the same cares in the grid', suggest 'the same care in defining the grid'.
Ok

P19, L538-543. This argument is not particularly convincing as a burning issue. Perhaps rephrase or omit.
Thank you for this remark. We rephrase this point and reduce it to one sentence.

P19, L545. 'than the one reached with the tidal forcing prescribed at open boundary conditions', suggest changing to ' than the one achieved with the tidal forcing at open boundaries'.
Ok

P19, L547. 'For that kind of standalone grids', suggest 'For this type of standalone grid'.
Ok

P19, L548. 'they enables to represent accurately', suggest 'enabling the accurate representation of'.
Ok

P19, L549. 'thanks to adapted open boundary conditions algorithm', suggest ' via the open boundary condition algorithm'.
Ok

P19, L550. 'performed once for good', suggest 'performed only once'.
Ok

P20, L553-555. This is confusing and doesn't get the point across. Please rephrase. 'They are not straightforward..' – what does this mean?
You are right, this is confusing. We wanted to say the differences were not one way or the other between the both nesting methods. For the sake of clarity, we delete this sentence.

P20, L557. 'maintains MARS3D good ability to', suggest changing to 'allows MARS3D to'.
Ok

P20, L559. 'exposed previously, suggest 'previously presented'.
Ok

P20, L565. 'large scales as the tidal forcing', suggest 'large scales such as the tidal forcing'.
Ok

P20, L570. 'boundary effect', suggest 'boundary effects'.
Ok

P20, L580. Why not make the standalone grid encompass the entire control volume, similar to the parent? Although, this would come at extra computational cost – would that be tolerable?
The standalone grid indeed encompasses the control volume but it should have the geographic extent of the parent grid (Iroise sea). In our case, this would represent an 8-fold size increase (6-fold by taking into account land value). The computation cost would then be multiplied by at least the same factor.

P20, L585. 'tidally flushed of the bay', suggest 'tidally flushed from the bay'.
Ok

P21, L590. 'conservative approach required', suggest 'conservative approach is required'.
Ok

P21, L587-591. A polar coordinate 1-way nest may achieve the same result. Even better would be an unstructured coastal or bathymetry weighted mesh. Perhaps mention the 2-way solution is not unique.
Thank you for this suggestion.

P21, L592. 'the AGRIF library flexibility allows to specify', suggest 'the flexibility of the AGRIF library allows the specification of'.
Ok

P21, L594. 'of the different', suggest 'to the different'.
Ok

P21, L595. There is no reference to the seven-zoom grid apart from its layout. Without evidence it functions this should probably be removed.
You are right, this could be misleading for the reader. We remove the term seven-zoom and let the regional configuration reference.

P21, L592-593. This is an important advantage of 2-way nesting, and should be highlighted up front. Experiments demonstrating this would really bolster the case for 2-way nesting.

Actually, it is already the case for meteorological forcings for the regional configuration. As AROME model does not cover all Europe, it only forced the zoom child grids. The mother grid is forced with ARPEGE model. On a more physical parameter, the horizontal turbulent closure consists of a Laplacian operator with a constant turbulent viscosity coefficient. This coefficient differs between each zoom ranging from 0.5 up to 3 $m^2 s^{-1}$. We highlight this aspect according to your rightful suggestion.

P21, L602. 'without additional task', suggest changing to 'without additional tasks'.
Ok

P21, L605. 'In situation where', suggest 'In situations where'.
Ok

P21, L606. 'checked once offline' – checked for what?
If a child grid is removed, the mother grid's bathymetry of the on the child grid area need to be recomputed in order to assure coherence between bathymetry at a center of a cell and its four borders required by MARS3D especially for wetting and drying scheme. We replace the sentence by saying "the mother grid's bathymetry has just to be recomputed before launching the model".

P21, L610. 'In such a perspective', suggest 'In such a case'.
Ok

P22, L623. 'with a refinement factor of 2 to 5'. Unstructured meshes have continuous resolution transition, and as long as this is sufficiently smooth, any refinement factor can be accommodated.
Yes, this was more a general comment from our bias experience with AGRIF in coastal areas. You are right that the refinement factor is the consequence of the physical and geographical aspects. As we reduce this paragraph, we delete this sentence.

P21, L623-630. If the hierarchy has not been actively exercised, with results to show, then probably best not to include reference to it.
Yes, because this development is still an on-going perspective, we decide to reduce it with just a short mention

P21, L634. 'allows to reach', suggest changing to 'allows us to reach'.
Thank you, the reviewer #1 suggest to change this sentence to "allow reaching" so we follow its advice.

P21, L640. 'to monitor marine environment', suggest 'to monitor the marine environment'.
Ok

P21, L641. 'the MARS3D model give the', suggest 'the MARS3D model provides the'.
Ok

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