Response to reviewer 1

We appreciate the time and effort taken to write this review, which has provided us with very useful feedback for this paper. Here we have considered and addressed all comments and questions from the reviewer and believe that we have improved the manuscript overall. Below is the entire reviewer response written in *blue italics* and our changes to the manuscript text in response to the reviewer are highlighted in red.

The manuscript "The characteristics of tides and their effects on the general circulation of the Mediterranean Sea" by McDonagh et al. presents a study investigating the effect of tides on the Mediterranean Sea circulation. To my knowledge, this subject has not yet been extensively investigated. Apart from Sannino et al. 2014, which provided a first analysis of the tidal influence on the large-scale Mediterranean circulation, previous studies have only focused on specific areas such as the Alboran Sea (Sanchez-Garrido et al., 2013) or the Sicily Strait (Oddo et al., 2023; Gasparini et al., 2004). As such, the present manuscript proposes a valuable contribution to reinforce and deepen the current knowledge on the tidal influence on the Mediterranean Sea.

In this study, the authors diagnose the effect of tides from a pair of 5-year-long tidal and non-tidal experiments based on very similar numerical configurations. The first and second sections of the manuscript investigate the influence of tides on the Mediterranean Sea dynamics through the prism of sea level and kinetic energy spectra. These analyses focus on three specific locations: the Strait of Gibraltar, the Tyrrhenian Sea, and the Cretan Sea. They reveal that tides impact high-frequency (> 1 day−1) dynamics through the propagation of the main tidal harmonics at work within the Mediterranean Basin and their interaction with various basin-scale modes. Then, the authors relate the tidally enhanced dynamics and mixing to the deepening of the mixed layer depth in the tidal simulation. The two final sections discuss the impact of tides on the thermohaline properties of the Mediterranean Sea and the transports through the Strait of Gibraltar.

Overall, the manuscript has the potential to provide valuable results on tidal contribution to Mediterranean dynamics. However, further work must be done before it can be accepted. More specifically, I think that although the two first sections of the manuscript provide valuable results, they focus on too specific areas to provide an overall picture of the tidal influence on the high-frequency Mediterranean dynamics.
We have expanded on the earlier sections of the results by providing maps (figure 4) of the sea surface height power spectra at specific frequencies, confirming the regions where tides interact with other phenomena.
In addition, to assess the influence of tides on the "general circulation of the Mediterranean Sea", as stated in the the title of the study, the manuscript should investigate the influence of tides on the long-term, large-scale circulation.
The general circulation of the Mediterranean Sea includes both long-term, large-scale circulation, and shorter-term, smaller-scale dynamics. We know already from e.g. Munk and

Wunsch (1998) that small-scale tidal mixing affects the overturning circulation of the ocean, and so the general circulation of the Mediterranean Sea includes both smaller and larger scales. Several decades of model integration, as in Harzallah et al., (2014), would be necessary to begin to understand the effects of tides on the longer-term overturning circulation directly, which was outside of the scope of this study. However, we can infer some potential effects on the large-scale circulation even with a shorter integration.

Regarding the impact of tidal dynamics, section 5 should more clearly distinguish the influence of local tidal mixing at the strait of Gibraltar, which impacts the Mediterranean mixed layer depth indirectly by changing the density of Atlantic water masses, and the less intense mixing induced by tidal currents throughout the Mediterranean Sea. The former is not directly related to the interaction of tides with the Mediterranean circulation, and it has already been investigated with similar model configurations (Sannino et al., 2014; Naranjo et al., 2014). Thus, I suggest not including it in this manuscript.

The introduction of local tidal mixing in the Gibraltar Strait is a valuable part of the investigation, because it demonstrates that local tidal mixing has an impact on the large-scale circulation of the whole Mediterranean Sea. The aforementioned literature describes the impacts in and close to the Gibraltar Strait, while our manuscript expands this to the entire Mediterranean Sea.

On the other hand, the mixing induced by tidal dynamics is relevant to this study. Finally, sections 6 and 7 are, in my opinion, outside of the scope of this paper. Although interesting, the corpus of these sections has no apparent link with Mediterranean circulation and mainly emphasizes the conclusions of previous studies without additional results.

We have moved section 7 of the manuscript to the supplementary material, while leaving section 6 in the main manuscript (more detail below).

For these reasons, I am arguing for a major revision of the manuscript. Specifically, I would suggest:

- *In sections 3 and 4: Add 2D maps of the tidal influence over the specific frequency bands mentioned in the text to give further confidence in the spatial extension of the results discussed.*

We added maps of energy density of sea surface height at 8.2h and 6h. These frequencies were selected as they had large changes in the tidal experiment for the whole Mediterranean, as seen in Figure 2. We added this commentary to go with the new figure (line 152): "Maps of the sea surface height power spectrum at 8.2h and 6h are shown for both experiments in Fig. 4. These frequencies are presented here as they show the largest differences between the two experiments, other than the tidal frequencies directly. Most of the Mediterranean Sea has enhanced power at 8.2h in the tidal experiment (Fig. 4a, c), with particularly large changes in the central Mediterranean: the Tyrrhenian Sea, the Gulf of Gabes, and the Adriatic Sea. The barotropic oscillation at 8.2h is in the Gulf of Gabes, according to Lozano and Candela (1995), but the third mode of the Mediterranean Sea (Schwab and Rao, 1983), and the nonlinear effects of tides in the central Mediterranean Sea according to Palma et al. (2020) are at frequencies close to this (8.4h and 8.0h respectively), and may also have an impact on Figure 4c. Since many of the calculations of barotropic oscillations in the Mediterranean Sea were made several decades ago, there is a need for an updated confirmation of the frequencies of barotropic oscillations using state-of-the-art methods. In Fig. 4b and 4d, we see that the Sicily escarpment region of Palma et al. (2020) again has particularly enhanced power in the experiment with tides, but other regions such as the Alboran Sea, and the western Mediterranean Sea see an interaction between tides and potential energy at the 6h frequency."

- *In section 5: If you intend to show that the tide-enhanced high-frequency dynamics are responsible for the deepening of the Mediterranean mixed layer depth, you should:*
    - *(1) Mostly focus on the overall increase of the mixed layer depth rather than its local increase over deep convection areas, where the intensity of tidal mixing is unlikely strong enough to drive the deepening.*

We separately show both the mostly increased MLD and mostly increased water mass formation rates in the Mediterranean Sea. The two are related but they are not the same: the deepening of the MLD can be a precursor or element of deep water formation, but it's not the only or most important process. More important precursors include weak stratification, and events such as localised cyclones. We find it interesting that the MLD increase is greatest in the Western Mediterranean Deep Water formation region, in winter, and especially in the years where a lot of deep water is formed, but this isn't enough to establish a connection. We have clarified the separation between these two results in the text (line 223): "The deepening of the mixed layer can be a precursor for increased dense water formation, but a direct analysis of this would be needed to confirm whether tides are enhancing water mass formation as well as mixed layer depth, and we note that the analysis in this work does not directly establish a connection between the two processes. Other important processes such as weak stratification and localised currents are key precursors to deep water formation in the Western Mediterranean."

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    - *(2) Look at the seasonal cycle of the mixed layer depth and stratification, as it would be easier to separate the effect of local vertical mixing from that of the tide-induced densification of Atlantic water masses at the Strait of Gibraltar.*

We added a second set of panels to Figure 13 (now Figure 10), showing a timeseries of the mean mixed layer depth and the difference between the two experiments. We also added some commentary for these parts of the figure (line 220): "Regarding the seasonality of mixed layer depth, the absolute and percentage change due to tides is positive throughout the year, but is greatest in winter. We also note that the largest increase in the mean mixed layer depth in the tidal experiment is evident during winter 2019, which is also the year characterised by the largest WMDW formation (see Fig. 11)"

- *Add some results on the influence of tides on the Mediterranean large-scale circulation, or reformulate the title of the article only to consider the high-frequency dynamics.*

As mentioned above, adding results regarding the effects of tides on the long-term circulation is outside the scope of this study, as a much longer model integration would be required. We focus our attention mainly on the smaller spatial and temporal scales in this work, which in turn make up part of the large-scale circulation of the basin.

- *Put sections 6 and 7 in the supplementary materials or a "model validation" section, demonstrating the consistency of the model with previous studies.*

We have moved section 7 to the supplementary material, but have kept section 6 in the main manuscript. We believe this section expands on the work of e.g. Naranjo et al., 2014, which confirmed the higher salinity and lower temperature of the inflowing water from the Gibraltar Strait. Further to this, we find that the changes in the salinity and temperature are consistent in the upper layer of the entire Mediterranean Sea.

- *I do encourage authors to make the necessary effort to improve this manuscript. You can find general and detailed remarks below.*

***General remarks**:*

- *There is no model validation. At least a reference to the model validation should be included.*

We have added references to the relevant model validation at the beginning of the Data and Methods section (line 79):
"The general circulation model used is NEMO v3.6, following the implementation of the Mediterranean Sea forecasting system operational in the framework of the Copernicus Marine Service (Coppini et al., 2023; Clementi et al., 2021). The area covered by the model is shown in Fig. 1. The model without tidal forcing is validated in Coppini et al. (2023) and as part of the model information in Clementi et al. (2019), while the experiment with tides is validated in the Quality Information Document in Clementi et al. (2021)."

- *The tidal and non-tidal simulations differ by other processes than tides. Please provide some information about the impact of these differences. The best would be to briefly analyze these impacts in the supplementary materials.*

We added a confirmation in the text that the impact of these differences is negligible compared to the impact of tides (line 121): "The effects of these changes are negligible compared to the effects of adding tidal forcing to the model (see supplementary materials)" This was shown through a preliminary analysis comparing the non-tidal experiment to an experiment, also without tides, which used the timestep and time-stepping scheme of the tidal experiment. We added two figures from this analysis to the supplementary materials, which demonstrate that the effect of changing the time integration scheme is negligible compared to the effect of adding tidal forcing.

- *Text clarity: Please use as few indirect forms as possible to make the manuscript easier to read.*

We have reviewed the writing style of the manuscript to improve the clarity of the text.

***Introduction**:*

***General remarks**:*

The introduction is relatively well documented. I thank the authors for this time-consuming work. However, it would benefit from a more straightforward structure. As it is now, the introduction paragraphs discuss:

1. *Tides in numerical models and their relevance to large-scale circulation*

2. *Influence of tides at the Strait of Gibraltar.*
3. *Influence of internal tides in the Mediterranean Sea.*
4. *Description of internal tides and their influence on the global ocean and the Mediterranean Sea*
5. *Basin modes of the Mediterranean Sea*

I suggest you start with a general introduction, including the content in paragraphs 1 and 4, to introduce the various aspects of tidal waves, their influence on large-scale circulation and mixing, and how they are represented. Then, explain how the tides influence the Mediterranean Sea, as in paragraphs 2, 3, and 5.
We changed the order of the paragraphs as suggested, beginning with the general content on tides and internal tides in models of the ocean, and then later detailing the influence of tides on specific phenomena and regions within the Mediterranean Sea.

Also, you should further motivate the need for a deeper understanding of the effect of tidal motion on the Mediterranean circulation. In the current version of the manuscript, this is only mentioned in one sentence "Many of these free oscillations could be affected or enhanced by tides, especially considering their proximity to tidal frequencies."
We added further motivation to the end of this paragraph (line 44): "Palma et al. (2020) found additionally that spectra of kinetic energy in the Sicily Channel are enhanced at 8 hours and 6 hours due to the nonlinear effects of tides. These works demonstrate the potential importance of interactions between tides and higher frequency features of the Mediterranean Sea, but the interaction between tides and barotropic oscillations in the Mediterranean Sea have not been investigated using a state-of-the-art numerical model."

***Detailed remarks**:*

- *"Tidal forcing is a rather recent addition to large scale circulation models that start to have horizontal and vertical resolutions that allow for an analysis of tidal motion on the circulation" => This sentence is unclear. Do you mean that horizontal and vertical resolutions are now fine enough to represent tides properly? Please clarify this.*

We added clarification to this sentence (line 11): "Tidal forcing is a rather recent addition to large-scale circulation models of the ocean, since horizontal and vertical resolutions have become fine enough to allow for an explicit and more accurate representation of tides. This has given rise to novel opportunities to analyse tides and their impacts on the ocean circulation".

- *"Tides are now considered to be essential components of the large scale circulation" => You should provide references specifically investigating the influence of tides on the large-scale circulation, for example: Müller et al., 2010*

We added references (line 14): "Tides are now considered to be essential components of the large scale circulation (St. Laurent et al., 2002; Müller et al., 2010; Melet et al., 2016)"

- *"Recently, Gonzalez (2023) has revisited the tidal dynamics in the Gibraltar Strait, concluding that there are several tidal-induced hydraulic control points and the authors developed a specific mixing parametrization for the Strait." => The Ph.D. of Gonzalez*

(2023) does not directly investigate hydraulic control points at the Strait of Gibraltar. These were observed by (Farmer & Armi, 1985; Farmer et al., 1988) and discussed by Brandt et al., 1996; Vázquez et al., 2006; Vlasenko et al., 2009; Sánchez-Román et al., 2012; García Lafuente et al., 2013; Hilt et al., 2020.

We modified the references and reworked this paragraph (line 26): "For the Mediterranean Sea, several authors have depicted the importance of tidal motion for the Gibraltar Strait (Armi and Farmer, 1985; Candela et al., 1990; Harzallah et al., 2014). Armi and Farmer (1985) and Farmer et al. (1988) first observed the hydraulic control points that are induced by tides, and the importance of tidal dynamics and their variability in the region have been more recently discussed by Vázquez et al. (2006), Sánchez-Román et al. (2012), García Lafuente et al. (2013), and Hilt et al. (2020)."

- *"Harzallah et al. (2016) and Naranjo et al. (2014) found that tides at the Strait of Gibraltar: (1) increase the baroclinic volume transport, (2) increase the salinity of Atlantic inflowing waters through the enhancement of mixing, affecting the water mass formation processes further downstream from the Strait and (3) change the Mediterranean deep water outflow." =>*
    - *(1) As I understand it, Harzallah et al. (2016) do not state that tides increase the baroclinic volume transport. In fact, we can read from the abstract of the paper: "It is shown that tidal oscillations reduce the two-way exchange by interaction with the subinertial variability.". The fact that tides increase the baroclinic volume transport is not so evident to me. The paper of Gonzalez et al. 2023 shows that the computed transports through the Strait depend highly on the chosen definition for the interface between inflowing and outflowing waters. Instead of stating that tides increase the baroclinic transports, I suggest that you say they intensify the high-frequency dynamics of the Strait.*

We changed this part to (line 30): "(1) intensify the high frequency dynamics in the Gibraltar Strait"

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    - *(2)Tides also cool the Atlantic water masses, although to a lesser extent than they salten it.*

We added this to the sentence (line 31): "2) increase the salinity and, to a lesser extent, decrease the temperature of Atlantic inflowing waters"

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    - *(3) You should specify what properties of the Mediterranean deep outflow are changed.*

We added more detail and additional references regarding the outflowing Mediterranean water and how it is affected by tides (line 33): "Tides also change the Mediterranean water outflow, as demonstrated by Izquierdo and Mikolajewicz (2019), where outflowing water moves along the African coast in a model without tides, but currents are closer to climatology with tides, demonstrating a role of tides in the spreading of outflowing water. Moreover, Ambar and Howe (1979) found that tides increase the variability of outflowing salinity"

- *I cannot find van Haren et al. (2014) in the references. Please add it.*

We corrected this error.

- *I think there is a mistake in the reference of the paper of Harzallah et al. (2016), which was published in 2014.*

We corrected this error.

Data and methods*:*

Detailed remarks*:*

- *"Lateral open boundary conditions are used in the Atlantic Ocean and Dardanelles Strait (see Fig. 1)." => What dataset do you use to force the model at these boundaries? Please provide a reference.*

We added further detail and a reference for the boundary conditions of the model (line 87): "Lateral open boundary conditions are used in the Atlantic Ocean and Dardanelles Strait (see Fig. 1), are provided by the Copernicus Marine global analysis and forecast system (Galloudec et al., 2022) for the Atlantic Ocean and a mixture of the aforementioned global model and daily climatology derived from a Marmara Sea box model (Maderich et al., 2015) at the Dardanelles Strait boundary. Further details of the boundary conditions are found in Clementi et al. (2021)."

- *"Additionally, 70 monthly mean climatological freshwater inputs from 39 rivers are added to the surface layer." => Please provide a reference for this dataset.*

We added further detail and a reference for the river climatology dataset (line 90): "Additionally, monthly mean climatological freshwater inputs from 39 rivers are added to the surface layer. Several datasets are used for this: the Global Runoff Data Centre dataset (Fakete et al., 1999) for the Po, Ebro, Nile, and Rhone rivers, the dataset from Raicich (1996) for the Vjosë and Seman rivers, the UNEP-MAP dataset (Demiraj et al., 1996) for the Buna and rivers, and the PERSEUS dataset (Deliverable of Perseus, 2012) for the remaining 32 Mediterranean rivers which have a mean run-off larger than 50 m3s−1."

- *Please explain how you choose the constant values used in the vertical mixing parameterization.*

We added a reference for this(line 103): "In the model runs used, a and n are 5 and 2 respectively, following Tonani et al (2008)"

Sea level energy spectra*:*

General remarks*:*

In this section, you should emphasize the innovative aspect of your work more clearly. Oneway to do so would be to discuss separately the interaction of tides with basin-scale frequencies highlighted in previous studies, which you confirm here, and those your study is the first to highlight. Also, a short recap on your findings and their impact at the end of the section would be welcome.

The extra figure showing 2D maps at specific frequencies adds to the novelty of this section of the work: showing for the first time using state-of-the-art numerical models, maps of the barotropic oscillations and how they interact with tides. Further to this, we added a recap of the findings as suggested (line 161): “To summarise the analysis of sea surface height, we find that (1) tides affect the sea surface height on spatial and temporal scales away from those of the tides directly, (2) existing Mediterranean basin and regional barotropic oscillations at frequencies with a shorter time period than 12h are excited by tides, particularly at 6h and at several frequencies close to 8h, and (3) maps of the energy density at these frequencies reveal the distribution of these interactions in the Mediterranean Sea.”

Detailed remarks:

- *"energy is reduced in the tidal model at frequencies lower than 0.5 d−1 (longer than a period of two days)." => Please specify the frequency in days first, as done in the following.*

This has been changed (line 133): “energy is reduced in the tidal model at frequencies with a period longer than two days”

Kinetic energy spectra:

General remarks:

- *In my opinion, you should remove Figures 7-9 from the corpus of the manuscript. They are used only in a small paragraph, do not provide new information with respect to Figure 6, and focus on a relatively short period of 1 month.*

Most of the information from Figures 7-9 can be seen in either Figure 6, or Figures 10-12. We therefore removed Figures 7-9 and moved some of the discussion of the physical meaning of these plots into the other figures.

- *Figures 10-12 should be replaced by the equivalent of Figure 6 for the vertical velocities. This would make it easier to read the impact of tides on the frequency band mentioned in the text and make the results more robust, as they would integrate the 5 years of simulation instead of one month.*

We decided to keep these figures in their current form. We feel that Figure 12 (now Figure 9) in particular clearly shows the interactions between internal tides and near-inertial waves, where the patterns in the Hovmoller diagram show the wave-wave interactions between them. The rotary spectra in Figure 6 show the frequencies of both types of wave for the kinetic energy. We also note that we do not have hourly data available for the 3-dimensional variables for the entire five-year period, due to computational limitations.

Detailed remarks:

- *“We first calculate the rotary spectra for depth-averaged (barotropic) horizontal velocities” => Please include some explanation about the physical meaning of this spectra.*

We added an extra sentence to explain the meaning of the spectra (line 171): “We first calculate the rotary spectra for depth-averaged (barotropic) horizontal velocities (Fig. 5), for both clockwise and counter-clockwise components and then combine these to create the rotary kinetic energy density spectra. These rotary spectra visualise the time scales at which there is high kinetic energy at each selected point, over the entire water column"

- *"The spectra of kinetic energy density were split into vertical levels to consider baroclinic currents and internal wave modes. [...] characterising the Intermediate Water circulation in the basin." => It is unclear which Figure you refer to. I assume it is Figure 6, but it is confusing since you introduce it later. If the figure you refer to is not in the manuscript, specify it with the mention "(not shown)".*

This does refer to Figure 6. We added clarification (line 177): "We also analysed the kinetic energy spectra split into vertical levels, to consider baroclinic currents and internal wave modes, as shown in Fig. 6."

- *"implying the existence of internal tides as already shown by Gonzalez (2023)." => Here, you should refer to the paper of Gonzalez et al., 2023. Also, many studies investigated internal tides in the Strait of Gibraltar. It is consistent to cite Gonzalez et al. 2023 here, but if you want to cite it alone, you should write something like: "implying the existence of internal tides, recently highlighted in Gonzalez et al. (2023)."*

We added an additional reference here, to an earlier paper on internal tides in the Gibraltar Strait (line 184): "implying the existence of internal tides in the Gibraltar Strait, as shown by Morozov et al. (2002), and more recently by Gonzalez et al. (2023)"

- *"Two zero crossings appear, one approximately at 150m, the lower limit of the inflowing branch of the zonal [...]" => Please detail the implications of this result.*

We added some further information about the importance of this result (line 198): "Two zero crossings appear, one approximately at 150m, the lower limit of the inflowing branch of the zonal conveyor belt already described above (Pinardi et al., 2019), and the second at 300m. This is particularly apparent in the Gibraltar Strait (Fig. 10), where internal tide generation leads to increased tidal velocity in both directions. The continuation of this zero-crossing at 150m in other regions (Figs. 8-9) demonstrates the importance of internal tide generation at the Gibraltar Strait and how it affects the entire Mediterranean Sea general circulation, including in remote regions."

Mixed layer depth and water mass formation*:*

Detailed remarks*:*

"There is an increase in mixed layer depth with tides throughout most of the basin, with notable exceptions in the Gibraltar Strait/Alboran Sea region, and in parts of the Aegean Sea." => Please explain why the mixed layer depth responds differently to tides in these regions.

We added further context for this result (line 213): "There is an increase in winter mixed layer depth with tides throughout most of the basin, with notable exceptions in the Gibraltar Strait/Alboran Sea region, and in parts of the Aegean Sea. In the Gibraltar Strait, this is explained by a thicker interface layer (Garcia-Lafuente et al., 2013), which shrinks the upper layer compared to the experiment without tides, reducing the depth at which the threshold density change for the mixed layer is reached. These effects extend into the upper-layer Alboran Sea water which originates in the Gibraltar Strait. In the Aegean Sea, despite having low amplitude barotropic tides, internal tides are present (Alford et al., 2012), and affect mixing at the bottom (Gregg et al., 2012) which likely in turn affects the water column structure in this shallow region."

Temperature and salinity:

Detailed remarks:

"As indicated in work by Naranjo et al. (2014) and Harzallah et al. (2016), inflowing salinity at Gibraltar increases when tides are introduced and upper layer temperature decreases" => You should also cite the papers of Gonzalez et al 2023, Sanchez-Roman et al., 2018, and Sannino et al 2014,

We added the additional references suggested (line 328): "As indicated in work by Naranjo et al. (2014), Harzallah et al. (2014), Sanchez-Roman et al. (2018), and Gonzalez et al. (2023), inflowing salinity at Gibraltar increases…"

The Gibraltar Strait:

General remarks:

You should specify how you compute the inflow and outflow transports through the strait of Gibraltar. As discussed in Gonzalez et al. 2023, it significantly impacts the transport values obtained.

We detailed the method used to calculate these values (supplementary material): "Net water mass transport through the strait at a given longitude, over the five-year period, was calculated as … where Q is the net water mass transport, η is the sea surface height, z is the depth, and u is the mean zonal velocity. This transport can be split into eastward and westward components: … where Qin is the upper-layer eastward transport, Qout is the lower-layer westward transport, and H is the Heaviside step function, H = 1 if u > 0, H(u) = 0 otherwise". The ellipses here are equations which are added to the supplementary material of the manuscript, along with this entire section.

Detailed remarks:

"Gonzalez (2023) recently demonstrated that the required resolution for an accurate representation of the Gibraltar Strait would be about five times the one used in our model." => It is Sannino et al., 2009 who discuss the resolution needed to represent the Strait of Gibraltar, not Gonzalez et al., 2023.

We corrected this reference (supplementary material): "We argue that this is due to the relatively coarse resolution of the model in the Gibraltar Strait, since Sannino et al. (2009) demonstrated that the required resolution for an accurate representation of the Gibraltar Strait would be at the sub-kilometer scale, many times greater than the one used in our model"

***Figures**:*

Fig1: Please adapt the colormap so it is possible to see the tidal amplitude in the Atlantic. I understand tidal amplitudes significantly differ over the Mediterranean and the Atlantic, making it difficult to plot both with one colormap. However, you could use one colormap for the Atlantic and one for the Mediterranean. Also, add the tidal phase in contours to display amphidromic points.

We updated this figure to include the phase and colourmap in the Atlantic Ocean.

Fig. 2: Add the scale in days for the two lower panels. Please indicate the frequency you refer to in the text using dashed lines and display the labels of tidal harmonics next to the associated peaks.

We updated the figure with the additional barotropic oscillations and tidal harmonics.

Fig. 3: Please indicate the frequency you refer to in the text using dashed lines and display the labels of tidal harmonics next to the associated peaks.

We updated the figure.

Fig. 4: I do not find any reference to the bathymetry in the manuscript, so you should indicate the points specified here in Figure 1 and remove this figure.

We removed this figure and added the points to Figure 1.

Fig. 6: Please add a panel displaying the differences between the two simulations.

We added this panel.