We thank the first reviewer for his/her effort on the review, the careful reading and for the constructive comments and suggestions to improve the paper. Below you find your comments and our response on each point.

P1 Line 23: The first sentence feels clumsy – consider omitting (you explain in more detail later on anyway) or at least add a reference for this (quite bold) statement

We have omitted this sentence.

P1 Lines 23 – 28: what is the point you are trying to make by mentioning the acceleration in MSLR? Maybe it would be more helpful to look at total increases in SLR? This is what really will affect coastal areas. Are there more recent references?

We mention especially the past acceleration of SLR, because the numbers illustrate in a striking way that changes are already going on. We revised this introductory text passage. We included numbers for total future increases in mean sea level rise and refer to the recently published IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC 2019, 2019).

P1 Line 28-29: worth including a reference and eluding to the reasons for this.

We added references and modified the text passage in order to better explain the connections.

P1 Line 28: highlight why changes in the tides are important – water level variations, extreme water levels, species distributions, changing currents, etc

We revised this part of the manuscript.

P1 Line 29 – P2 Line 7: are the changes you mention here due to changing tides or changing sea level? If the latter then they feel slightly out of context.

We are referring to changes in tidal dynamics but these changes are directly related to changes in mean sea level. We modified the text passage to explain this more clearly.

P2 Line 25: what sort of shelf models are you referring to here? Tide models? OGCMs?

The shelf models meant are tide models. In the manuscript we included examples to clarify this aspect.

P3 Shelf Model description(s): Given that your work is all about tides it would be helpful to include more information on the calculations of the tides in the model. How is bed roughness dealt with? Internal tides? Is this a 2D or 3D model? What happens at the open boundaries?

The DSCMv6FM is a 2D model based on the shallow water equations that includes tide generating forces. Surge calculation is based on the inverse barotropic correction. At the open boundary 22 tidal constituents are used from GOT00.2 (Q1, O1, P1, K1, N2, M2, S2, K2, 2Q1, σ1, ρ1, χ1, π1, ϕ1, θ1, 2N2, μ2, ν2, l2, L2 and T2) and 16 partial tides from FES2012 (Ssa, Mm, Mf, Msf, Mfm, S1, J1, M3, MNS2, R2, M4, MN4, MS4, S4, M6 and M8). Thus tides are produced/affected by two mechanisms, by astronomical factors (gravitational attraction between Earth, moon and sun, rotation of the Earth-moon and Earth-sun systems) and by non-linear processes (e.g. friction due to bed roughness) that affect the tidal constituents when propagating across the model domain.
The DCSMv6FM uses a spatially varying bed roughness. We modified the text passage to complete the model description.

P3 Line 19: are you really using GOT00.2? The latest version is GOT4.7

Yes, we are using GOT00.2. We believe that the data set is sufficient for our purpose, since this study is a case study and we are running both models with the same forcing. Thank you for the remark. We plan to update these data for future studies.

P4 Line 5: why would you want sediments in your model?

Since the numerical model UnTRIM² is principally able to compute the transport of suspended sediment, with this sentence we want to make clear, that for this study we have this process not included. In our study the focus lies on the response of tidal dynamics to sea level rise. The transport of suspended sediment is computationally intensive and not of primary relevance to tidal dynamics. To clarify this point, we included a short explanation.

P4 Line 7: What parameters are used in the subgridscale option? How does this feed into the shallow water equations? Do both models have this option? How does turning this option on and off affect the results?

Subgrid allows using coarser computational grids with high resolution data for bathymetry at subgrid level. The advantage of this technique is that large time steps can be used in the simulation due to the coarser computational grid. The algorithm that correctly represents the precise mass balance in regions where wetting and drying occurs and was derived by Casulli (2008) and Casulli and Stelling (2011). The computational grids are allowed to be wet, partially wet or dry. This implies that no drying threshold is needed. With the subgrid option the accuracy of the simulation results can be improved when using the same classical computational grid. Comparable results to simulations with a classical grid are obtained with using a coarser computational grid but with the subgrid technique. (Sehili et al., 2014)

For further information on the implementation of this method in the shallow water equation we refer to equation (7) in Sehili et al. (2014).
The DCSMv6FM uses the new flexible mesh capacities D-Flow-FM. The flexible mesh technique is another designation for the classical unstructured grid concept and thus, in contrast to the German Bight Model, does not include subgrid information.
We included the information on the subgrid option in the model description of the German Bight Model and clarified that DCSMv6FM does not use subgrid information.

Table 1: It would helpful to include a root mean square error here as this gives an additional measure of the absolute model error rather than the relative error you get with the bias.

We added the rmse and the bias of the M2 amplitude at all stations in the table 1.

P6 Line 7: explain RMSE*?

RMSE is the root-mean-squared-error normalised with the standard deviation.*
We added this in the manuscript.

P6: Given that you mainly discuss changes in M2 amplitude later on, it would be helpful to include an evaluation of the model performance in simulating the tides against the amplitudes at the stations and possibly also against a product such as TPXO or FES. This is probably more important than including an analysis of the water levels as it is not clear through which processes the water level errors arise (i.e. your model could perform very well at simulating tides but not for storms or vice versa).

We chose a validation period in which wind velocities are small. Thus water levels are not influenced by storm surges. For this reason we believe that if the model simulates water level well it also simulates the tidal constituents (such as M2 amplitude) well. To complete the picture we, however, added the bias for the M2 amplitude between the measurements and the models at the stations in table 1.
In our opinion products such as FES or TPXO are not suited for validation purpose in our case. They are designed to model tides in the deep oceans. The bias increases on the shelf and especially at the coast where shallow water tides dominate. The error of these models on the coast is larger than the error we see in our validation. (https://www.aviso.altimetry.fr/en/data/products/auxiliary-products/global-tide-fes/description-fes2014.html)

P7 line 12 – 13: This statement is not clear to me – why do you add SLR at the open boundary rather than over the whole domain? Is this the case for both models?
Can you explain in more detail how the model deals with flooding areas, i.e. the wetting and drying scheme? How does that work at low water and sea level rise? Surely, with SLR more normally dry areas are flooded and more energy is lost there?

Water levels within the model domain are dominated by the forcing at the open boundary. Adding the mean sea level rise at the open boundary is a simple way to introduce sea level rise into the model domain. It would be more straightforward to add mean sea level also to the whole domain at the initial time step of the simulation period. However, the water signal introduced at the open boundary travels within a few days across the whole model domain. We chose the initialisation time of both models to be sufficiently long that a dynamical equilibrium is reached before analysing the data.
At the open boundary of the DCSMv6FM the mean sea level rise is added as a constant factor in the formula that calculates the tide using several harmonic constants (Zijl et al. (2013) eq. 1). At the open boundary of the German Bight Model water levels are used from DCSMv6FM which already include the effects of mean sea level rise on the shelf. At the corresponding text position in the manuscript we added this information.

Most numerical models control wetting and drying using thresholds for a minimum water depth. The models set the flow velocity to zero and take points out of the computational domain when a certain drying threshold is reached. Those points are "reactivated" when the water depth increases over the flooding threshold. The algorithm used in UnTRIM² is directly derived from the governing differential equation and is a substantial part of the numerical method. It guarantees mass conservation and allows any computational cell to be wet, partially wet or dry which is detected by having precisely zero water depth. No drying threshold is needed. For further information concerning the wetting and drying algorithm we recommend (Casulli, 2008) and the literature within. We have added the additional literature in the manuscript.

In principle rising mean sea level leads to a flooding of former dry area and thus more energy is dissipated on these areas. But it depends on the profile of the flooded area. If it is a steep profile then it could be that in the sum more or less the same amount of energy dissipates with or without MSLR, because the water depth increases (and dissipation decreases) in areas that were already flooded without mean sea level rise. When having a flat profile the area on which dissipation takes place increases more relative to the decrease of dissipation caused by deeper water levels. Thus no general statement is possible.

P7 Simulations: How do you deal with open boundary tidal forcing with sea level rise? Harker et al. (2019) show that using present day tides at the model open boundaries leads to large changes in tidal responses on the Australian Shelf – can you comment on this for your work? Similarly, global studies such as Mawdsley et al. (2015) show global changes in water levels. Work by Wilmes et al. (2017) show global tidal responses to large-scale sea level changes on the levels of your 10 m simulation.
Do you allow for flooding in the large SLR scenario? What coastal defences do you assume?

Thank you for this remark. Sea level rise will affect global tides. We, however, assume that the tidal constituents will not change at the open boundary of the shelf model DCSMv6FM. We add mean sea level rise as a constant value to the boundary conditions. For our study this is a reasonable assumption since it is designed as a conceptual study investigating the interaction between sea level rise and the representation of the bathymetry in the coastal zone. Our study does not characterise the future development of the tides. We clarified this point in the discussion.

Besides the uncertainty due to the assumption that the tidal constituents do not change at the boundary condition there are other uncertainties we did not account for. As mentioned in the paper one of the largest uncertainties is how the bathymetry near the coast will change due to MSLR. Due to mean sea level rise, e.g., a vertical growth of tidal flats is expected. Such changes in coastal bathymetry will affect tidal dynamics in the German Bight.
The wetting and drying algorithm is in principle still working when simulating large sea level rises. However, in the scenario with MSLR 10 m the model is flooded at all times, since the water cannot escape. The model domains of the models have a fixed vertical wall which is so high that it is not possible to flood the hinterland.

Figure 4: Why does Emden have such a large error?

Emden is located in the inner estuary of the Ems. Therefore it is a station which is principally harder to calculate in high accuracy. Especially with a model which has a relatively coarse resolution. We added the explanation also in the manuscript.

Figure 3: what are the units? Explain mNHN in the caption

mNHN denotes metres above the German datum which is a good approximation of mean sea level We added an explanation in the caption.

P10 Line 3: How do you calculate tidal amplitudes?

Tidal amplitudes are estimated by a harmonic analysis of tides (Pansch, 1988), which is based on a Fourier decomposition of the water level time series into harmonic functions of prescribed tidal constituents. We added this explanation in the paper.

P10 line 4-5: omit sentence

Changed in the manuscript

Figure 6. Which model performs better at the present-day tides?

It is hard to decide which model performs better at present-day tides only from the picture since there is no spatial dataset of measurements. Both results seem plausible.
The comparison to measurements at individual gauges shows that both models calculate the tidal dynamics sufficiently accurate and the results of both models are in the same order of magnitude (see table 1). The DCSMv6FM performs slightly better in comparison which is probably a result of the calibration method (see 2.1). For the present day this calibration method provides good results but the question arises if this is also the case for future projections.

P19 lines 4-5: ‘”The response to a MSLR of 10 m is more comparable in both models” – the differences between the two model setups are probably on a similar magnitude or larger as for the 0.8m SLR scenario, however, they are masked by the larger-scale differences occurring on the whole shelf area (whereas for a 0.8 m SLR the shelf-scale changes are much smaller). I would, however, argue that there are pretty big differences between Figure 6 e and f, especially around the islands in the southern part of the domain where the difference amounts to over 1 m in amplitude.

Thank you very much for this comment. This is a very important aspect. You are right. We plotted the differences between Figure 6f and e and also between Figure 6d and c (supplement Figure S1). The differences in the region offshore of the North Frisian Wadden Sea are smaller but in a similar order of magnitude as in the case of MSLR 0.8 m. In the South the differences have opposite sign. That means, in contrast to MSLR 0.8 m, the response to MSLR 10 m in the shelf model is smaller than in the German Bight model.
We modified the section 3.1 accordingly.

P19 lines 32-33: I’m not sure I agree – see comment above. The differences locally are pretty significant. Your large-scale, regional or shelf-wide responses are similar, but then arguably they are also similar (i.e. not very much happens) for small sea level increase.

Following the argumentation of your comment above, we modified this statement.

P20 line 24: “For higher mean sea level rise scenarios (10 m) the resolution of the bathymetry is less important” see comments above. I would conclude that, if looking at complex coastal areas such as the German Bight, highly resolved nearshore bathymetry is important for assessing the impact of sea level changes in these complex areas as the local responses can differ from the regional, offshore tidal changes. This is the case whether the forcing is large or small.

After explicitly comparing the differences of the responses (see above) we agree. We deleted the statement in the conclusion. Thank you again for your careful reading and your remarks on this aspect.

3 Technical comments
P2 Line 21: “1m” – space needed; also check remainder of the document
Changed in the manuscript

P2 Line 23: defence -> defences
Changed in the manuscript

P2 Line 28: After “Thus” add a comma
Changed in the manuscript

P10 Lines 3 – 4: Figure 6 shows for both numerical models the M2 amplitude and its changes in response to mean sea level rise in the region of the German Bight.
-> Figure 6 shows the M2 amplitude and its changes in response to mean sea level rise in the region of the German Bight for both numerical models.

Changed in the manuscript

Table 2: You have quite a lot of different cases – remembering what case study 1 referred to later on in the manuscript is hard – why not label them something intuitive like GBM_ref_CS1 -> GBM_ref_NE and GBM_80_CS2 -> GBM_80_NE_CB

Changed in the manuscript

Figures 7 onwards: rather than having lots of single plot figures it would be better to condense your individual images into one or two figures with more subplots like you have done in Figure 6.

Changed in the manuscript

P13 lines 8 - 9: Similar to the shelf model the M2 amplitude increases in this case study in the German Bight. -> The M2 amplitude increases in the German Bight in this case study are now similar to the shelf model changes.

Changed in the manuscript

References

Casulli, V.: A high-resolution wetting and drying algorithm for free-surface hydrodynamics, Int. J. Numer. Meth. Fluids, 60, 391–408, https://doi.org/10.1002/fld.1896, 2008.

Casulli, V. and Stelling, G. S.: Semi-implicit subgrid modelling of three-dimensional free-surface flows, Int. J. Numer. Meth. Fluids, 67, 441–449, https://doi.org/10.1002/fld.2361, 2011.

IPCC 2019: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, in press, 2019.

Pansch, E.: Harmonische Analyse von Gezeiten- und Gezeitenstrombeobachtungen im Deutschen Hydrographischen Institut, Deutsches Hydrographisches Institut, Hamburg, Wissenschaftlich-Technische Berichte 1988-1, 2350, 1988.

Sehili, A., Lang, G., and Lippert, C.: High-resolution subgrid models: Background, grid generation, and implementation, Ocean Dynamics, 64, 519–535, https://doi.org/10.1007/s10236-014-0693-x, 2014.

Zijl, F., Verlaan, M., and Gerritsen, H.: Improved water-level forecasting for the Northwest European Shelf and North Sea through direct modelling of tide, surge and non-linear interaction, Ocean Dynamics, 63, 823–847, https://doi.org/10.1007/s10236-013-0624-2, 2013.