Response to the second review of Modelling extreme water levels using intertidal topography and bathymetry derived from multispectral satellite images

All comments given in the previous review have been taking into account and they are reflected in this superior version of the work. I would like to highlight all the effort made in rewriting the paper and, in particular, the Introduction. The aims are clear and the reasoning is good. That said, I still have some concerns about the implementation and the analyses of the application. I think that the concept "one paper, one idea" should be take into account here, because the main results might vanish among the other relevant results. However, authors have proved that they are more than capable of addressing my considerations.

Thank you for your positive comments on the modifications made in the first round of revisions. We acknowledge your time and effort put in this second review. Below you can find your comments answered one by one in blue font. Your original comments are in black font.

Major Comments

1) I understand the aim of Figure 1 and appreciate the effort done, but quite confusing. Your description in the paragraph starting at line 104 is clear. I suggest, in any case, more work on the text.

We have made changes to the Figure 1 symbols and text in the manuscript. Now the text closely follows the figure. Lines 106–118.

2) In line 16 it's said that the system is assessed during a storm surge event, but only tidal levels are presented. In fact, the utilized model, which validation is presented in the Supporting Material, considerations only the tide as external forcing. Why is it not forced with atmospheric fields? As you state in the Introduction, the storm surge peaks can reach values close to 30% of the tidal signal; hence, the incorporation of the atmospheric signal may be more than relevant. Indeed, I wonder if the incorporation could change the results presented in Section 3.4.

We have included 4 additional simulation scenarios (explained in Section 2.6, lines 308–318). They include storm surge signal. We investigated two different extreme events recorded at the Moturiki tide gauge. They have similar magnitudes at the peak of water-level (~1.4 m) but one has less storm surge contribution (~22%) than the other (40%). Note that we forced the model with water level time series (which includes astronomical tide and storm surge), but not wind or atmospheric fields. We

agree that the use of wind/atmospheric fields in the model would have been interesting addition, because it can change the storm surge inside the estuary. However, given that the aim of our work is to assess SBD/SDT topo-bathymetry in modelling storm surge, and our paper is already quite long, we would like to leave this for future work.

3) Based on the scale of the region, the tide presents wavelength of about hundreds of kilometers and the Rossby radius of deformation of about tens of kilometers. Therefore, the tide has cooscillant dynamics rather wave propagation. Furthermore, due to the large scale of the process, it natural that the tide doesn't "feels" the improves achieved with the presented methodology. It's a restriction of the physics instead of the modeling. It would be interesting, in a future work, to perform a similar analysis with a relatively short wave such as wind waves.

We have included your observation on lines 531–532:

"Furthermore, the tidal wavelength is hundreds of kilometres, which means that the water level should not be affected significantly by smaller-scale bathymetric features."

4) In line 237 it says that astronomical tide analyses was undertaken, why do you apply the analysis? What information is utilized for this? Given the dimension of region, I expected that it to be nested or, at least, forced with tidal global models.

The model is forced with the local astronomical constituents of the tide record at Moturiki tide gauge. Due to the proximity of the tide gauge to the entrance of the estuary, we consider this a simple and reliable way to model the water level within the estuary. We are aware of the limitations of this assessment and highlighted them in the discussion section in numerous parts. For instance, Sect. 4.2 (lines 528–545) and 4.4 (lines 625–632).

5) Some sections in Methods deserve more work to highlight the main ideas. For instance, Section 2.3, 2.5.1, 2.5.2, 2.6 and even Fig. 6 present brief descriptions and rely mainly on the Supporting Material. I recommend summarizing the main concepts needed to discuss the results and adding these few sentence before discussing the corresponding results.

Change made. We have re-written part of the paragraphs of Section 2.3, 2.4, 2.5.1, 2.5.2, and 2.6 to make them clearer. We first write what we are doing, and then why we are doing it. Modifications can be seen in the tracked-changes document. We also improve the link between the first paragraphs of methods and discussion. For instance in Sect. 2.3 the first two paragraphs we make it clear that we are comparing ratio-log and waterline and why. In Section 4.3, we start the discussion by directly comparing

the methods, as follows:

"The results show that, for Tauranga Harbour, the waterline and the ratio-log techniques performed similarly for the task of deriving topography over intertidal zones using satellite images. Thus, for estuaries with low water column turbidity, pre-existing surveyed topo-bathymetric data, and low numbers of available satellite images covering its area — as is the case of Tauranga Harbour — the ratio-log method could potentially replace the waterline method for deriving elevation data for intertidal zones. Although the waterline method shows better performance when considering the RMSE — either evaluated on a point-to-point basis (0.20 m) or evaluated using the DEM (0.23 m), see Table 3 — than the ratio-log method (0.25 m). Evaluating RMSE using the DEM provides more information for comparison. Figure 12 shows the density SDT points and distribution of the relative vertical error (RE) for Tauranga Harbour's waterline-SDT and ratio-log-SDT for intertidal zones, where the colour represents positive (red) or negative (blue) errors. Positive (negative) errors indicate that SDT estimates are deeper (shallower) or further landward (seaward) than the LiDAR data (see Sect. 2.7). The waterline-SDT (Figure 12: a1, b1, c1, d1) provides estimates that are generally shallower or further seaward than the LiDAR — as the negative RE indicates — with the worst estimates in the tidal flat's upper region (bluer colour dots). The positive RE values (redder colour dots) are concentrated in the estuary's wide flat centre region (Figure 12 b1) and indicate that the estimates are deeper or further landward than the LiDAR data. As discussed in Sect. 4.1, the waterline method is mainly limited by the number of images required to properly define the morphology of the study site. In the case of Tauranga Harbour, as consequence of the high complexity of its morphology, the SDT provided by the present framework could be substantially improved with more images, making the waterline method even more accurate than the ratio-log method. "

Similarly, we repeat the rationale for Sections 2.5.1, 2.5.2, and 2.6. We also made the description of Figure 6 more clear (please see the markups).

6) For a better reading and to stress the main results, I suggest authors to merge Discussion and Conclusions and summarize the content.

We understand and appreciate your point; however, because we are discussing different points in the discussion (separated in subsections), and that initial reviews found our paper confusing (and also reviewer 2), we would like to retain a separate discussion so that we can clearly lay out our main findings using subsections.

Minor comments

1) There are still inconsistencies in unit system, for instance lines 14, 15 and 16.

Change made: all units are in metres through all the document.

2) In line 122 the term is “storm surge”, please correct that expression throughout the manuscript.

Change made: the term was changed for storm surge as required throughout the manuscript.

3) In line 330 please be careful with the use of the correlation in this context, is it correlation or the goodness of fit? In any case, are they tested?

Change made. We changed the term for the goodness of fit (line 367). Goodness of fit is tested for Tauranga Harbour results, as shown in the results section.

4) For a better reading, before the analysis, first introduce the figure and its aim.

Change made. We have introduced first the figure and its aim before analysis for Figure 7 (lines 364–371). We also tried to follow this pattern throughout the manuscript, whenever practicable.

5) In section 3.4 homogenize the statistical evaluation, please use the same scores for a better interpretation.

Change made. We homogenized and clarified the text in Section 3.4.

6) In line 386, what is the third part?

We have removed this sentence from the manuscript.

Typo

Q1 - l8 Should be “,e.g.,”

Done. Re-arranged for “used in models..” (line 8).

Q2 - l16 The sentence is too wordy, please rewrite to stress your idea.

Done. The sentence was modified (lines 16–19) *“The use of SDT in numerical simulations of surge levels was assessed for Tauranga Harbour in eight different simulation scenarios. Each scenario explored different ways of incorporating the SDT to replace the topographic data collected using non-satellite survey methods. In addition, one of these scenarios combined SDT (for intertidal zones) and SDB (for subtidal bathymetry), so only satellite information is used in surge modelling.”*

Q3 - L38 Should be “areas, respectively”.

Done. Line 39

Q4 - L58 SBD is not defined yet.

It is defined in the previous paragraph (line 52).

Q5 - L87 SBD and SDT were defined above.

Yes, they were. SDB (line 52); SDT (line70)

Q6 - L125 Remove “study site”

Done, removed from line 125. It is study areas now.

Q7 - L130, L231 Error in latex citing reference.

Done. Reference removed to clarify the text. The reference is used in the discussion Section 4.1.

Q8 - L135 Was or is?

We re-arranged the sentence to: “the topography data consisted of the LiDAR survey, with a spatial resolution of 1 × 1 m, available on the Land Information New Zealand (LINZ) data portal (https://data.linz.govt.nz/)” (lines 142–143).

Q9 - L184 The equations should be separated according to the reading flow.

Done. Please see lines 190–200.

Q10 - L207 Should be “2d”

Done. Corrected at line 222.

Q11 - L209 SDT or waterline-SDT?

Done. We re-wrote the sentence to clarify. We use the term waterline-SDT hereafter. Line 222.

Q12 - L247 Please avoid expressions such as the last sentence.

Done. Sentence was replaced with “*For details on the model calibration and validation, see Supplement B.*” line 262.

Q13 - L287 The statistical scores acronymous are not defined yet.

Done. We have deleted this sentence. The full name of the statistical scores and acronymous are explained in Section 2.7.

Q14 - L327 MRE is not defined.

We have adjusted the term. We meant BIAS. We have adjusted Figure 7, equation 8, and the text (lines 364–373) according.

Q15 - L534 IWD is defined but then it’s not utilized.

Done. “IWD” was removed from the text. (line 618)

Q16 - L554 SLR stands for sea level rise?

Done. We replaced “SLR” with “sea level rise”. (line 618)

I have finished my report on the revised version of Costa et al. 'Modelling extreme water levels using intertidal topography and bathymetry derived from multispectral satellite images'. I'm happy to inform that I'm more satisfied with the current version of this study which clarified several issues I had from the original submission. However, I still think the revised manuscript is quite complicated to understand and unbalanced (e.g. compare length of results vs methods). Part of the difficulties I have to comprehend relates to the use of the language and the length and complexity of methods. The latter extends from pg 5 to 15 excluding details allocated in supplementary material. The revised submission needs a good review by the authors emphasizing on the appropriate use of scientific language (conciseness, objectiveness, etc…) and attention to detail. As an overseas academic based in Australia whose first language is not English, I understand some of the language difficulties are not restricted to Mr. Costa only. A thorough revision is therefore needed. This should start on Ln3 (missing space between L.L.); full address for 1 and reduced address for 2 (Ln4 and 5) and follows down all the way to the reference list. The figures are difficult to understand and the captions need improving. Since the study was conducted in similar estuaries in NZ, a revised discussion would also need to contemplate the range of estuarine morphologies and forcing for the international audience. Below are some of the minor issues I detected.

We are pleased that the reviewer appreciates the modifications made in the first round of revisions. We acknowledge your time and effort put into this second review. Below you can find your comments answered one by one in blue font. Your original comments are in black font.
We are aware of the complexity of the manuscript. We have made extensive modifications to improve clarity and conciseness, which we hope will satisfy your requirements. These are shown in the marked-up copy of the manuscript.

We have also addressed all your questions. We also have re-written most of the methods section to first express what we did and why we did it and linked the methods clearly to the corresponding discussion section. For instance, in Sect. 2.3, the first two paragraphs clarify that we are comparing ratio-log and waterline methods and why. In Section 4.3, the corresponding discussion section, we start the discussion directly comparing the methods, as follows (lines 547–563):

"The results show that, for Tauranga Harbour, the waterline and the ratio-log techniques performed similarly for the task of deriving topography over intertidal zones using satellite images. Thus, for estuaries with low water column turbidity, pre-existing

surveyed topo-bathymetric data, and low numbers of available satellite images covering its area — as is the case of Tauranga Harbour — the ratio-log method could potentially replace the waterline method for deriving elevation data for intertidal zones. Although the waterline method shows better performance when considering the RMSE — either evaluated on a point-to-point basis (0.20 m) or evaluated using the DEM (0.23 m), see Table 3 — than the ratio-log method (0.25 m). Evaluating RMSE using the DEM provides more information for comparison. Figure 12 shows the density SDT points and distribution of the relative vertical error (RE) for Tauranga Harbour's waterline-SDT and ratio-log-SDT for intertidal zones, where the colour represents positive (red) or negative (blue) errors. Positive (negative) errors indicate that SDT estimates are deeper (shallower) or further landward (seaward) than the LiDAR data (see Sect. 2.7). The waterline-SDT (Figure 12: a1, b1, c1, d1) provides estimates that are generally shallower or further seaward than the LiDAR — as the negative RE indicates — with the worst estimates in the tidal flat's upper region (bluer colour dots). The positive RE values (redder colour dots) are concentrated in the estuary's wide flat centre region (Figure 12 b1) and indicate that the estimates are deeper or further landward than the LiDAR data. As discussed in Sect. 4.1, the waterline method is mainly limited by the number of images required to properly define the morphology of the study site. In the case of Tauranga Harbour, as consequence of the high complexity of its morphology, the SDT provided by the present framework could be substantially improved with more images, making the waterline method even more accurate than the ratio-log method."

Given our paper is a test of different techniques, we think it is important to have a solid methods section, but we acknowledge that it was a little long, and have made an effort to make it more concise.

Minor:

Q1 - Ln 12- four instead of 4

Done. Line 12.

Q2 - Ln24 sea-level rise instead of sea level rise. Please revise this throughout paper (E.g. Ln34…). Note that we write 'sea level' and 'sea-level rise'.

Done. Revised throughout the paper.

Q3 - Ln36 Not sure I agree with the fact that inundated areas in estuaries are generally shallow. What do you mean by this assertion? What do you consider shallow? 2, 5, 20, 50 m below msl. Some estuaries are deeper than that.

Done. We removed the comment in parenthesis *"which are normally shallow"*. Now

the sentence is written as follows (lines 37–39):
"In estuaries, there are permanently inundated areas and intertidal zones, which are flooded and exposed by the tide. Here we define the terms bathymetry and topography to reflect permanently-inundated and intertidal areas, respectively ".

Q4 - Ln 37 Consistency--Consider placing 'which are areas flooded and exposed…' into (). Alternatively take out the () of 'which are generally shallow'.
Done. We have reworded this sentence (lines 37–38).

Q5 - Ln 44 reword this sentence as the way it is written it seems that ~70% of the coast has not been surveyed, when in fact the whole world has been surveyed. What scale are you talking about? Make sure you are referring to large scale (e.g 1:100)
Done. The sentence was re-worded as follows (lines 45–46): *"Consequently, according to IHO (2020), approximately 70% of the world's coastal areas have bathymetric surveys that need updating or are insufficiently detailed (e.g., are of large scale 1:100)."*

Q6 - Ln 104-113 _ Is this explanation needed on a scientific paper? This seems to be a statement adapted from Mr. Costa's thesis. Please consider revising it.
Done. A description of the sections was requested in the first round of reviews, and that is why we put so much detail in the previous version. We agree with the comment, and have modified the text to closely follow the Figure 1 (lines 106–119).

Q7 - Ln115 you previously indicated that you had three specific objectives (Ln98). Do you want to elaborate more on this Fig caption to indicate that (a) not only shows the steps taken to derive SDT/SDB but also to investigate stats relations/sources of errors?
Done. The legend of Figure 1 has been changed accordingly:
"A flow chart showing the main structure of the manuscript. The panel (a) shows the steps taken to derive the SDT/SDB and how the statistical relationships and source of errors were investigated. The panel (b) summarizes the framework to test the utility of SDT/SDB in modelling high water levels."

Q8 - Ln118 What's Aotearoa? Some part of text you say Aotearoa NZ, some others are only NZ. Is there a difference? for the international reader?
Done. We have changed the text throughout the manuscript. We now refer to the country "New Zealand" as "Aotearoa New Zealand". Aotearoa is the Māori name for New Zealand. It means "the land of the great white cloud". In NZ, there is a treaty between the crown and Māori that requires us to provide equal weight to Māori interests, and we have been advised that using "Aotearoa New Zealand" shows

support for respecting this Treaty (it has also become common practice in NZ). Our funding body also requires us to show the ways in which we are respecting the Treaty in our work. .

Q9 - Ln119 (Figure 2A) Ln 120 the spring tide ranges from 1.4 to 1.9 m within estuaries
Done. We have modified "Figure 2A" for "Figure 2a" and remove the "within estuaries". Line 126–128.
Q10 - Ln121-123- Revise text. Is the use of BUT appropriate? I don't understand what's being said here. Storm surges add <0.5 m but the max surge was 2,29 m? I guess you mean the extreme sea level. Similar for the next sentence--- Tauranga = 0.88 m
Done. We have re-written the text as follows (lines 127–132):
"The sites consist of barrier-enclosed sandy estuaries which are common in Aotearoa New Zealand (Hume et al., 2015) and all have micro-tidal regimes — the spring tidal range varies between 1.4 m to 1.9 m – and spring tides combined with severe storm surges drive the extreme sea levels (Rueda et al., 2019; Stephens et al., 2020). In Aotearoa New Zealand, the storm surges usually add ≤ 0.5 m to the water level; however larger storm surges can occur occasionally (Stephens et al., 2020). The extensive intertidal zones and vegetation (e.g., seagrass and mangrove) that are present in the majority of the estuaries in Aotearoa New Zealand can attenuate tides (Tay et al., 2013) and storm surges (Montgomery et al., 2019)."
Q11 -Ln135 1 x 1 m – Add space
Done. Line 142.

Q12 - Fig 2 I have a major cartographic issue with this figure. Your use of different shapes and colours is completely inappropriate here. It makes the reader completely lost. See: You use coloured circles to represent the four locations (nothing wrong with it!). Then in B, you use different symbols with different colours and sizes to represent the different gauges. This is clearly a thematic cartography problem as we don't normally vary all three elements at once. In doing so, I tend to relate the Moturiki gauge with the Tauranga Harbour in A – they are both green circles! Then you complicate things with the D plots: Omokoroa is represented by black stars when legend in B shows red star, Hairini is also a black triangle and Oruamatua a black box. Finally, you mess it up one more time with the yellow and red symbols in legends! When I read the caption to try to understand this Fig, I don't find a reason why you have four gauges in B and only three plots in D. What's wrong with Moturiki (Green)? You need to spend more time on this figure. A lot of your issues come from the symbology in B. Try to make it easier for the reader.
We have modified Figure 2 to remove confusion. The symbols now follow a logical

colour and shape.

Q13 - Ln191 The threshold is set using the Otsu approach (Otsu, 1979) – Refine text to avoid repetition of the author's name

Done. We modified the text to *"…The threshold is set using the Otsu (1979) approach…" (line 204).*

Q14 - Table 1 – Surface area column – Round the area values to represent the approximation you indicated. Why are they in italic?

Done. The number were rounded and the font italic was removed.

Q15 - Fig 3 – This Fig summarises the framework for deriving topographic data. OK, but what is 4 PostProcessing? Why is this stage not explained as the other three? Why does it come before 3 in this framework? The caption also needs attention. It indicated that this is the framework and that NDWI is the index used, but stops there. The caption is extremely limited for such a complicated figure!

Done. Step 4 post processing was eliminated from the figure. We refer to post-processing as a manual quality control step where incorrectly identified waterlines were eliminated (for example, as caused by a small cloud or shadow of the cloud). This is explained in the text (lines 168–176). The legend was re-written as:

" Figure 1: The framework for application of the waterline method to derive topographic data in intertidal zones. First (1) an image collection was acquired. Second (2), the intertidal zone was identified by calculating the temporal of NDWI. Note that NDWI is the index used to detect the existence of water from satellite reflectance (see text). Third (3), the waterline position and height were determined. This was done by identifying the boundary between wet and dry cells within the intertidal zone (i.e., waterline) and assigning a height value for the waterline obtained from the local tide gauge observation at the time of the image acquisition."

We hope now with the improvements to the legend, the main text, and the text embedded in the figure,provide a better understanding of the method.

Q16 - Fig 5 – Make this a 3 x 3 plot figure instead of a 4x4x1. Use your programming skills to make better use of the page's space.

Done.

Q17 - Ln 225 What is a sub-estuary? Please clarify.

Done. We modified the sentence to (lines 237—240) :

"To compare, the ratio-log method was applied to an image acquired at high tide,

where the intertidal zone was completely flooded. The numerical assessment was built on a pilot study in Costa et al. (2021), where the method was trialled in small region within the Tauranga Harbour."

Q18 - Ln247 Can you expand on "The model approximates the predicted data well (Sup B)"? How well? Please use a stat method to be more precise here. A single sentence will do it. Then refer to Sup B.

Done. To improve the conciseness of the text, we modified the sentence to: "For details on the model calibration and validation, see Supplement B." (line 262)

Q19 - Ln255- Rewrite this sentence to indicate that only groundwater can be a potential source of error. If that's what you mean

Done. Note that there are several factors that can affect the waterline method, groundwater is only one of them. We re-wrote the paragraph (lines 266–270) as follows:

"The first method to correct the waterline-SDT trialled was to remove the statistical bias—potentially caused by conditions that can interfere in the pixel reflectance and as consequence, the waterline position at different tide levels within the tidal flats. Conditions that can interfere with detection include the complexity of the intertidal zone morphology, water turbidity, variation of the benthic substrates (sand, seagrass), and groundwater seepage. Specifically, groundwater seepage leaves a film of moisture on the exposed intertidal detectable in images (Huisman et al., 2011). "

Q20 - Ln263 - 265– Rewrite paragraph to make your point clearer for the reader.

Done. See comment above.

Q21 - Ln330/331 I assume R2 is R^2 Please use superscript. Revise whole text

Done. We put superscript in all text.

Q22 - Ln332 – There's no Figure 6C

Done. Figure 7c (line 368).

Q23 - Ln335 – Is this a separate equation or part of plot 7?

It is contained in plot 7c. We made this more clear in the text. Line(369).

Q24 - Fig. 8 - Align the bottom two plots in relation to the second and third columns

Done.

Q25 - Ln359/365 Use spaces RMSE~7cm, etc…

Done. We added space in these cases in all manuscript.

Q26 - Fig 10 Why are the gauge symbols different from Fig2? Delete the ‘)’ from y-axis in top left plot (after 60S)

The figure was modified address the issues raised by the reviewer (symbols and typos). Note that as part of the reviewing process, we added new simulation scenarios and the figure setting has changed.

Q27 - Ln386-390 – Discuss with your co-authors the need of this paragraph. This is supposed to be a discussion of your results and not a summary of what was done!

Done. The paragraph was deleted.

Q28 - Ln391 ‘Our’ – Throughout text you write possessive forms. Stick to scientific language. Avoid Ours, We, etc… What about: ‘4.1 Waterline method for….limitations’; 4.2 Correction methods for… ?

Done. Possessive forms removed from the section’s titles and text.

Q29 - Ln400 New Zealand

Done. We changed to “Aotearoa New Zealand’s” (line 445)

Q30 - Ln 401 Our results also show.

Done. Text modified to (line 446): *“Environmental conditions such as the complex morphology, varied bed substrates, and groundwater seepage could reduce the accuracy of the waterline position.”*.

Q31 - Ln401-402 I’m not sure I understand this discussion. I was under the impression that all estuaries were quite similar and only groundwater had the potential to reduce the accuracy. Here you are indicating that that environmental conditions such as complex morphology can also reduce it. There’s a weak argument here. Maybe you referring to the different estuarine types and stages of evolution and how this can interfere with results but this needs better arguments and references. Given the range of estuaries and the international audience of this journal. Is there space for micro x macro tidal discussion in here? Is NDWI a good proxy in macrotidal settings or flat (low slope) shorelines?

Ground water seepage is only one of the factors that could cause errors in the waterline method. We explain this better now in Section 2.5.1. NDWI is widely applied

in other studies, however, other techniques can be used to determine the intertidal zones and waterline (we discuss these in this same section, lines 482–490). We understand that international readers will not be familiar with the estuaries that we have studied. We have add text that they are barrier-enclosed micro tidal estuaries and a reference a paper that classifies our estuary types (Hume et al. 2007, 2016). We now made clear that the tidal regime is important in the waterline method (lines 466—468).

Q32 - Ln 455 Rewrite we are not eliminating horizontal errors. This is not scientific language at all!

Done. We have re-written the sentence as follows (lines 509–510): *"Note that in the dynamical correction, just the waterline height is corrected, and the observed waterline position remains unchanged."* .

Q33 - Fig 11- I'm completely lost here. What am I looking at? I see the three profiles. The points are waterlines, but the map has lines, which I suppose are SDT WLH according to the legend below…Not sure what you mean here. Then on the right, you indicate p1 being the dyn. Corr, WLH 1; p2 being the dyn corr WLH2… Do you see what I am seeing?

We have rewritten the paragraph in the manuscript that refers to the figure (lines 501–517). The figure clearly shows three different waterlines throughout the estuary (green, red, blue lines) plotted on the map and profiles intersecting these waterlines (m1). The profiles and the intersections are represented by points in panels p1, p2, p3 (the right panels). We simplified Figure 11 and made it more concise.

Q34 - Ln483 Capital letters- Check manuscript for proper names. We say Arcachon Bay, Maketu Estuary (Ln317)

Done. These have been changed throughout the manuscript.

Q35 - Ln492 This is such a big claim considering that your method was only tested locally under limited conditions and restricted estuarine settings. Please reframe this to place your findings accordingly.

Done. We have changed the text as follows (lines 547–551):

"The results show that, for Tauranga Harbour, the waterline and the ratio-log techniques performed similarly for the task of deriving topography over intertidal zones using satellite images. Thus, for estuaries with low water column turbidity, pre-existing surveyed topo-bathymetric data, and low numbers of available satellite images covering its area — as is the case of Tauranga Harbour — the ratio-log method could

potentially replace the waterline method for deriving elevation data for intertidal zones."

Q36 - Ln492 – 508 You keep indicating that the waterline-SDT performs better than the ratio-log-SDT, but the text suggests that the latter is done on px-by-pixel basis. Is this the reason why the former outperforms the latter? Shouldn't you be comparing only the lines here?

Done. We have rewritten several paragraphs of Section 4.3. We clarify the comparison between methods and results. In addition to the changes in response to Q35, the first paragraph now reads (lines 551–563):

" Although the waterline method shows better performance when considering the RMSE — either evaluated on a point-to-point basis (0.20 m) or evaluated using the DEM (0.23 m), see Table 3 — than the ratio-log method (0.25 m). Evaluating RMSE using the DEM provides more information for comparison. Figure 12 shows the density SDT points and distribution of the relative vertical error (RE) for Tauranga Harbour's waterline-SDT and ratio-log-SDT for intertidal zones, where the colour represents positive (red) or negative (blue) errors. Positive (negative) errors indicate that SDT estimates are deeper (shallower) or further landward (seaward) than the LiDAR data (see Sect. 2.7). The waterline-SDT (Figure 12: a1, b1, c1, d1) provides estimates that are generally shallower or further seaward than the LiDAR — as the negative RE indicates — with the worst estimates in the tidal flat's upper region (bluer colour dots). The positive RE values (redder colour dots) are concentrated in the estuary's wide flat centre region (Figure 12 b1) and indicate that the estimates are deeper or further landward than the LiDAR data. As discussed in Sect. 4.1, the waterline method is mainly limited by the number of images required to properly define the morphology of the study site. In the case of Tauranga Harbour, as consequence of the high complexity of its morphology, the SDT provided by the present framework could be substantially improved with more images, making the waterline method even more accurate than the ratio-log method. "

Q37 - Fig 12. Fix caption –missing) after d1. Expand caption to explain why left is better than right.

Done. The caption of Figure 12 was modified according to the requirements as follows:

"Figure 12: Estimated SDT and corresponding relative vertical error (LiDAR-SDT) for intertidal zone in Tauranga Harbour using waterline-derived (a1, b1, c1, and d1) and ratio-log (a2, b2, c2, and d2) methods. The root mean-squared error for waterline method is 0.20 m and for the ratio-log method is 0.25 m (not shown in the figure). However, the waterline method results in less density of estimates (due to imagery

constraints), while ratio-log method results in a pixel-by-pixel estimate density. Background image: ESA Sentinel 2A. Date and time of the background image acquisition: 18/12/2018 10:15 h.“

Q38 - Ln518 would be more uncertain than what?

Done. We change the sentence to (line 586): *“Consequently, determining the intertidal areas would be less accurate in environments with high concentration of suspend material.”*

Q39 - Ln593 onwards: My editorial eye couldn’t let this pass without a comment. A comprehensive revision of the reference list is needed. There are references in CAPITAL letters; typos; several words together; wrong author names; wrong abbreviations; lack of abbreviations, missing information; etc… These start in the very first ref (below) but extent throughout the list Almeida, L. P., Efraim de Oliveira, I., Lyra, R., Scaranto Dazzi, R. L., Martins, V. G., andHenrique da Fontoura Klein, A.: Coastal Analyst System from Space Imagery Engine (CASSIE): Shoreline management module, Environ. Model. Softw., 140, 105033, https://doi.org/10.1016/j.envsoft.2021.105033, 2021. Some of these issues are observed on a single ref.: ‘Costa, W., Bryan, K. R., Coco, G., Zealand, N., andZealand, N.: ASSESSING THE USE OF SATELLITE DERIVED BATHYMETRY IN ESTUARINE STORM SURGE MODELS – STUDY CASE : TAURANGA, 2021.

Done. A thorough revision of the references formatting has been done.