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Comment on nhess-2021-387

Anonymous Referee #1

Referee comment on "Modelling extreme water levels using intertidal topography and bathymetry derived from multispectral satellite images" by Wagner Luiz Langer Costa et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-387-RC1>, 2022

The manuscript presents an interesting approach to deriving intertidal bathymetry from the waterline method through multispectral images, covering four (4) estuarine study areas on the east coast of Aotearoa New Zealand's North Island (Tauranga, Ohiwa, Maketu and Whitianga harbour). It represents a current thematic area, and it can be particularly useful to be applied in remote or inaccessible areas or where the bathymetric or cartographic data is very outdated. The main objectives of the study are to determine if multispectral images can be used to extract accurate intertidal bathymetric area and to assess the use of the SDB for hydrodynamic modelling of estuarine.

Good English level however the manuscript is not well-structured, quite confusing and the reader easily misses the main guidelines and the aim of the study. In section 1 (Introduction) is very difficult to establish a connection between the different ideas and paragraphs. A deeper revision of the state of the art is needed to bring the reader into the SDB theme and waterline method. The flow chart in chapter 2 is useful but does not really explain the methods used by the authors. Furthermore, the Methods Chapter establish that the main method was divided into 2 steps (1-SDB estimation and 2-Hydrodynamic modelling assessment) and that step 1 is also two methods for removing the bias, but a clear explanation of the methodology is not present in this section of the manuscript. A very short discussion and a shorter conclusions section are shown, where no clear main findings can be found. Modelling Storm surge is only referenced in the title of the manuscript.

The manuscript shows that a lot of work has been made, however, a big gap throughout the presented structure is noticed and the methodology used is not well described, creating a lot of misunderstanding between the methods applied and the different steps described by the authors. I, therefore, do not recommend the publication of this manuscript as it was presented. A major revision of the structure and methodology form is recommended. My main critics are the following:

- In the Introduction section the theme is not quite explained, and only part of the aim of the study is presented in the last sentence of the last paragraph. In this section is expected that the authors explain the reasons that have motivated this study, as well as what will be presented in the different sections of the entire manuscript.

- The different figures do not follow a consistent presentation. The geographic coordinates in some cases are presented as latitude/longitude with no reference datum associated (Fig.2(a)); others as X/Y coordinates (km) WGS84/UTM60S (Figs. 2 (b), (c), 3 (a)) and even other examples as X/Y coordinates NZGD2000 (km).

- The same Figures, presented in different sections, have different SI unit references, like Fig.2 (b) and (c) are expressed in X/Z coordinate (**km**) and Figures S1 and S2 in X/Z coordinate (**m**) – show a lack of consistency.

- The areas A, B, C and D depicted in Figure7 (central figure) are not quite perceptible, and the small figures (a1, a2, b1, b2, c1, c2, d1 and d2) do not have geographic coordinates associated, neither the scale factor.

- The profile lines drawn in Figure 9 (m1) are barely noticed. Maybe the authors could choose a different colour palette.

- In the text, the figures are not correctly cited, like Fig 2A (line 85); Fig 2B and 2C (line 88). In the Figures, the panels are mentioned with small letters (a, b and c), as well as in the figure capture.

- The data access information at the reference links (lines 94-97) is missing.

- I do not understand how the intertidal area is identified, the method is not well explained. Is used the tidal level at the time of the acquisition of each image? Or is used an average tidal range (tidal amplitude?) for all the images. Is also not clear the tidal level for each image, as depicted in Figure 2(d). All images are used to generate the intertidal area presented in Figure 3(a)?

- The threshold value used, and all the contour extraction method (lines 153-159) are quite confusing. And which values of threshold and water level were used for the other study areas, regarding that Figure 4 presents the water level and threshold values for each image. A table with this information, for all the different study areas, as supplementary information could be very useful.

- What do you mean with the Stumpf-ratio method was applied for deeper areas (lines 164-165). The Stumpf ratio method (Stumpf et al., 2003) is not quite good for all different benthic areas and for very deeper areas. What was the maximum depth value which the authors have used this method?

- It was not explained by the authors all the pre-processing steps applied to the multispectral images, such as sun glint correction (for example Hedley, J.D.; Harborne, A.R.; Mumby, P.J. Simple and robust removal of sun glint for mapping shallow-water benthos. *Int. J. Environ.* 2005, 113, 2107–2112). If this step was considered, it should be enunciated in the manuscript. The authors described that Level 2 image was used, with BOA values corrected for the effects of the top-atmosphere (lines 103-104), but it was not explained why they used these images rather Level 1 with atmospheric correction.

- I can not understand if the evaluation of the model performance in section 2.4 is one of the results of this study. And if they are, why not present them in the results section? Lines 201-215 have a challenging interpretation.

- Why an "Average" line in table 3. Does not make sense.

- Lines 234-239 should be included in the Discussion section, not here, where the results are presented.

- In the ESA Sentinel 2A images used as background in several figures are missing the data acquisition time and the water-level information (Figures 2, 7, S1, S2, S3, S5, S6, S7).

- The authors cannot quantify as good or strongly correlated/related the R2 achievements (lines 242-245). Why R2=0.70 should be considered as strongly related? Once more the authors are discussing the presented results in the Results section, and it is a recurrent procedure throughout this section. Perhaps if the authors had previously described in section 1 the contents of each section, the reader could understand better the manuscript. The structure of each section is quite confusing.

- Lines 274-278: R2 values assumption/classification (low/higher). And R2 is referred to as the coefficient of determination (line 276) and a coefficient of correlation (line 278) in the same paragraph. Is not coherent.

- The authors do not explain why the results and the application of the methodology were only presented for one study area (Tauranga Harbour). They are free to do it, even for editorial figures or pages restrictions, however, this fact should be mentioned and

explained in the manuscript and the main results for each area should be resumed (table format perhaps) in the supplementary material section.

- What is the spatial grid resolution value (line 298)? Is 20 m as assumed in line 336?

- Lines 313-316 are quite confusing. A better explanation is needed.

- The prediction of water level using the SDB is presented in section 3.4 for the 3 tide gauges (Omokoroa, Hairini and Oruamatua) (lines 323-331). The average error parameter presented is for each tide gauge and Figure 10 shows the average between all the tide gauges. Was this methodology that was used? I am confused.

- Can I assume that, for lower tide values images, the presented methodology can not be used? Or only for the Stumpf ratio method application (SDB)? Lines 338-341. The Stumpf ratio method can not be directly applied to intertidal areas, exactly due to the image reflectance of the dry pixels (low water level images).

- What represents the rectangle-shaped figure in Figure 11? Survey bathymetry data or LIDAR data?