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Comment on nhess-2021-387

Anonymous Referee #3

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-RC3>, 2022

I have read the paper entitled "Modelling tides and storm surge using intertidal bathymetry derived from the waterline method applied to multispectral satellite images" by Costa et al. The study aims to determine whether satellite imagery can be used to extract accurate intertidal bathymetric data; and assess the use of the SDB for hydrodynamic modelling of estuaries. The paper is interesting, and one can see that quite a lot of effort, based on the complex methodology, was put into it. However, the manuscript is quite confusing making it difficult to understand. Part of the problem I had was regarding the use of the term SDB to represent extracted shorelines when the term is coined to deriving bathymetry. The study seems to have its merits but needs a complete re-structure. I found results difficult to understand.

Because it presents lots of technical concepts, I'd divide this paper in two manuscripts and focus on convincing the reader that waterline extraction can be useful to derive intertidal DEM in NZ and leave the SDB and modelling approach for another opportunity. A short discussion is also presented in this submitted version for such complex topic. Therefore, a major revision or complete new submission is recommended

It is not clear to me why one would embark on a shoreline extraction method to create an intertidal model, when one could use SDB (Stumpf and others) to obtain bathymetry, especially where white water/waves are absent.

I found the introduction a quite confusing as it mixed two different uses of satellite. One to derive bathymetry and the other to derive shoreline positions. This is carried out from the Abstract to Introduction to the other parts of the text, and therefore I suggest a complete rewrite of these sections.

Some specific points below:

L9 - I'd suggest to modify text to make better use of the acronym – Satellite-derived bathymetry (SDB) which obviously differ from “use of satellite images to estimate bathymetry”

L11 four instead of 4. Same in L16

L18 The use of the satellite derived bathymetry in hydrodynamic models does not result in significant differences in terms of water levels, when compared with the scenario modelled using surveyed bathymetry. This seems a big claim to me considering that the method was only used in microtidal settings and NDWI performance in macrotidal places can be more complicate due to the larger wet areas. Sea grass bed areas appears also to be an issue.

LN23- what about meteorological tides? They seem quite important for predicting floods

LN24 no hyphen in sea level

LN25- to my knowledge atmospheric pressure is the one driving storm surges along the coast, fluvial discharge definitely adds to it, but it is the difference in pressure that elevates the water level

Ln34 the references following this sentence should focus on SDB and not shoreline “To overcome these issues, efforts have centred on using spaceborn remote sensing (RS) techniques (Bishop-Taylor et al., 2019; Bué et al., 2020; Caballero and Stumpf, 2019),” should be replaced

LN41 Again I don't think the Bishop et al. ref is appropriate here, as their article addresses shoreline and not bathymetry

LN 42 rewrite "use a radiometric approach, which uses the property that different wavelengths are attenuated to varying degrees in the water column"

LN55 detecting the land-water boundary has nothing to do with deriving bathymetry with satellites. The shoreline is the interface not the morphology of the seafloor. Bishop et al., didn't derive bathymetry. They derived intertidal DEM, linking terrestrial and bathy datasets

LN57-59 only here I start to get a feeling of why you are talking about SDB, but even after that I think that you are creating a DEM of a few mts-depending on the local amplitude- instead of lets say shallow water bathymetry

LN71 bathymetry. You are talking about creating a DEM based on shoreline positions. Some of these positions will be above tide datum. Does that make bathymetry or topography?

LN77 2 main steps (Fig. 1).

LN78 two instead of 2

LN88 the intertidal zone is easily distinguished by the colour of sand accentuating reflectance in the near infrared band – This sentence seems out of context or needs some further clarification as Fig 2 is not a false colour image.

LN89 Associated with tidal flats, mangrove forest can be observed in all the studied estuaries. Where can I observe mangrove and seagrass banks? Modify text

Ln92 I get confused here." For the implementation of SDB techniques, only tidal levels and imagery are needed. We used additional in situ bathymetric data to validate the SDB." Do you need bathy or not for implementing SDB?

LN114 t seems to me that some of the derived shoreline elevations cannot be considered bathymetry and this is part why I don't like the use of the term for this shoreline extractions. Some of the elevations will be above MSL. Can you still call it bathymetry? Shouldn't be topography then?

LN140 you are using NDWI to define the intertidal area. Please explain how the 9 images for Tauranga or the 7 for Ohiwa are capturing the full extent of the intertidal area. Where they acquired during the lowest-highest tidal range?

LN156 Again- colloquialism

LN157 (Fig. 4)

LN158 once the waterline for a given image is identified, a height value is assigned to it accordingly to the corresponding tide level observed at the closest tide gauge (Omokoroa for the Tauranga Harbour case study, Fig. 2D). I see 4 gauges in the estuary. What's the rationale for choosing Omokoa? Oraumatua seems way closer to let's say Rangataua Bay! How do you account for the tidal lag? The level at the entrance is different than at the head.

Ln202 hyphen mean-sea level

LN259 Tauranga Harbour's waterline-derived SDB (primary SDB)- Sometimes I get really lost- What's primary SDB and how it differs from the other SDBs. Please explain

Fig 8 font size too small

Fig 9 Why are the coordinates in this map in NZGD? This figure needs to be improved. The colour scheme does not allow differentiation btw gauges and lines. It has 2 contradicting legends showing water lines as points and lines. Where are the LiDAR and the dynamic waterlines? Are they only shown in profile? I bit confusing to understand

LN323 The simulation scenarios showed that it is possible to obtain similar, or even enhanced water level predictions, by using the SDB rather than the surveyed bathymetry – I'm a bit lost here. My understanding is that we need bathymetry to do SDB! At least I had to use a few lines in the past.

LN 383 Bathymetric data are fundamental for solving the hydrodynamic equations in shallow water – This seems obvious, isn't?

LN396 Is that it? A 1.5 pg long discussion, for such a complex paper?

