We would like to thank the reviewers for their careful readings and constructive criticisms. The suggested modifications have been a decisive help to improve our manuscript. Specific comments are addressed one by one hereafter. Reviewers' comments are in regular blue font, our replies are in regular black font, text extractions in black italic font, and modifications in red font in the Track Changes version of the manuscript.

Reviewer #1

The paper presented by Seyfried et al. provided a multidisciplinary approach focused to define the best flooding prevention model for the Saint-Malo bay area. As well-known this region is often interested by very amplitude variation coupled to always more frequently occurrence of extreme weather and marine events. Considering this context a set of initiatives focused to define a global forecasting model to prevent risk of coastal flooding started in the 2018. The authors provide very intriguing integration of bathymetric investigation and a plenty of oceanographic datasets useful to build-up a risk-management model for the coastal region of Saint-Malo and neighbouring municipalities. The manuscript is well written with a detailed introduction about the political framework and all the actions achieved by the local municipalities and the National entities. As general observation, the morphological description is a little weaker than the part about the description and interpretation of oceanographic data. A more detailed discussion about the seafloor morphology could be added. My major remarks is related to the final discussion of the results. Considering the plenty of oceanographic datasets, the effort to achieve a detailed bathymetry, a forecasting model of 20 m (or 30 m as also stated) of resolution seems not adequate. To be honest this should not be considered a negative result, but I would like to arise this point in order to trigger a further discussion about any possible strategy (for the future) focused to improve of the model.

Following the reviewer's recommendation, we made efforts to improve section 2 focusing on the processing of the topo-bathymetric dataset. We also bring some insights regarding the seafloor morphology in section 2.3:

Although the creation of TBDTMs is only a prerequisite for the flood prevention model, it also enables us to describe the main morphological characteristics of the area under study. For the Saint-Malo harbor and surrounding area, the TBDTM covers an area of 85 km² (Figure 3.b). At its center lies the mouth of the Rance, reaching a depth of around 10 m, 3 km downstream of the tidal power plant. The estuary extends further north, near Cézembre Island, through an incision in the coastal shelf along which the depth reaches 15 m. At the east of the estuary, there is an important accumulating bedform, the bench of Pourceaux, made of coarse sands (Bonnot-Courtois, 2002). The rest of the foreshore is characterized by smaller marine sedimentary deposits and submerged rocky structures, which provide partial protection from the prevailing north-westerly swells. Apart from harbor infrastructures, the intertidal zone is characterised by sandy beaches in between rocky outcrops. The beaches are relatively small, with the largest, the Sillon beach, that stretches along 3 km across a former marsh, on which a large part of Saint-Malo is located. The beach is topped by a protective structure, the Paramé dyke. On the TBDTM, the height of the dyke varies between 14.3 m and 15.8 m above chart datum.

Concerning the reviewer's major remark, it is stressed section 4.2 is dedicated to the description of an ongoing modelling effort based on phase-averaged wave modelling that would be the core of the flooding forecasting system. As pointed out by the reviewer, it is worth noting that the high resolution of the DTM (5 m) and the spatial density of the dataset would allow a setup of the model with refined computational grids. The choice of the resolution at the coast should actually be the best compromise considering the modelling approach adopted (either phase-averaged as considered here or phase-resolving), practical aspects regarding model implementation and the computational coast. Considering our modelling approach, a finer resolution would be too costly for operational purposes. Second, increasing the resolution at the coast with nested grids would require an additional intermediate grids in Hycom. Finally, a phase resolving modelling approach allowing an explicit representation of the free surface and a better representation of wave transformations in the nearshore area would be more appropriate at higher resolution. Such models are currently too expensive for operational use although benefiting from active developments on the numerics to reduce their computational cost (Couderc et al., 2017; Marsaleix et al., 2019; Duran et al., 2020; Richard, 2021). Accordingly, we elaborate a bit more our choice regarding the modelling strategy in section 4.2.

Minor comments and suggestion are reported in the attached pdf file

L107 Total propagation Uncertain is linked to the amount of acquired soundings and especially to the overlap between adjacent running lines. Please provide the percentage of overlapping used to obtain this (very good) results

Our work was carried out in accordance with IHO recommendations, with a minimum overlap between adjacent lines of more than 50 % of the half-swath. This information has been added in section 2.1.1.:

The Total Horizontal Uncertainty (THU, (IHO, 2017a)) at the 95% confidence level is between 0.55 m and 3.1 m. With a minimum overlap between adjacent lines of more than 50% of the half-swath, the 3 bathymetric surveys are compatible with orders 1a and 1b of the IHO S-44 standard.

L160 Could you specify what rules are used to define whether a dataset is supersede or completed?

We have specified the main rules based on the metadata, with the age, density, uncertainty and IHO order of the surveys. A description of the deconfliction process, the so-called "Téthys"can be found in Le Deunf et al. (2023). We have improved paragraph 2.2 accordingly.

L163 I am wondering what happens in case of complete dataset. Are the new and older data merged together? If yes how? I mean. The integration of different data can be done using different approach ion the base of specific characteristic. For example if the resolutions of the two dataset is very different the merging procedure is tricky and often results to average the results of the two dataset.

Indeed, if no priority rule is identified between several overlapping surveys, then the (x,y,z) data are simply compiled in the reference layer. Using suitable deterministic spatial interpolators (such as splines) and the right resolution then generates a realistic surface and limits the presence of artefacts. This common practice, much discussed in the literature, is the compromise chosen to ensure complete coverage of the study area.

L175 Interpolation is used to merge multiple sources having different resolution and a coherent distribution. I am wondering how you corrected the offset between adjacent/overlapping areas. It is almost certain that two datasets recorded at different time and using different sensors can highlight offset errors along edge areas. In addition, how do you discern if that specific local offset is related to survey issue or instead to a real local variation of the seafloor that is changed during the time?

This is one of the main challenges we are still working on. Many people are actually involved in making the database used by the Téthys process more reliable, in order to check the consistency of the reference layer. In addition, the interpolation used and the density of the surveys compiled limit the presence of these offsets. If an unacceptable offset is detected during the evaluation, the status of the surveys is re-evaluated to ensure that the background is represented as homogeneously as possible. This can happen when two surveys complement each other, but one of them is much older than the nearby surveys.

Figure 1, put the resolution in meters
We have modified figure 1 accordingly.

L361 This is a major remarks about the model and the related forecasting. At this point in the discussion, the authors should explain what their vision is for improving the resolution of the model.
Please see our response to the first comment.

L370 A possible suggestion could be to concentrate efforts not on a single model based on limited periods but on a continuous collection of data with instruments that record continuously. So that the predictive model is constantly updated. Implement low-sampling, low-power systems with continuous data transmission (for example underwater acoustic data) that allow continuous updating of the model analysis algorithm.

We agree with the reviewer and believe the two strategies are complementary: carrying out a very intensive measurement campaign brings insights on the processes involved and allows to adapt the modelling strategy, while an operational model would benefit from a permanent network for Calibration/Validation needs, and ultimately overcomes the inherent spatial and temporal limitations of measurements. In that sense, the forecasting system would certaily benefit from the development of certain French national networks such as SNO-DYNALIT, REFMAR, RONIM, etc. Accordingly, we made some addings in section 4.2:
In addition, another strategy based on permanent networks, with low-sampling, low-power systems with continuous data transmission, could also be complemented by model assimilation and machine learning algorithms to adaptively improve forecast accuracy over time and add robustness and resilience to the system. This strategy would include collaborative aspects, involving stakeholders and local authorities, ensuring its success.
and in the conclusion:
Developing permanent national networks, with continuous data transmission, complemented by model assimilation and machine learning algorithms to adaptively improve forecast accuracy over time and add robustness and resilience to the system, seems a promising way forward

Reviewer #2

The manuscript submitted by Seyfried and co-authors offers a view on a wide range of data, surveys, and monitoring programs carried out by various French national stakeholders and competent authorities, propedeutic to the development of a flooding prevention action program, specifically applied to the municipality of Saint-Malo, which faces a small bay in the Norman-Breton Gulf, English Channel. Before considering any further evaluation of the quality of the paper, the manuscript needs substantial and careful re-wording and proof reading by a technical expert and English writer. I will explain myself better in the following specific comments by providing few examples to the Authors where wording and incorrect phrasing and terminology affect the quality of their submission. Moreover, I feel confused by the very first statements made by the Authors at LL36-44. Citing:"The Shom's contribution is based on various actions including: – the realization of in-situ oceanographic and bathymetric sea campaigns during the winter of 2018-2019 in order to obtain up-to-date Topo-Bathymetric Digital Terrain Models (TBDTMs) as well as a characterization of physical properties of the coastal zone; – the creation of a 42-year climatological hindcast to enable the definition of criteria for classifying high-risk storms and the calculation of joint return periods for static water height and waves, to characterize meteocean conditions favorable to coastal flooding and define warning thresholds; – the generation of a very high-resolution coupled modeling system in Saint-Malo to model the storm surge and to consider in the medium term, an operational local flooding forecast system This document describes and analyzes the first action. The data acquired are a prerequisite for the following 2 actions." Therefore, the paper seems to be about the acquisition of bathymetric and oceanographic data in the area of interest, however paragraph 4.2 deals with surge and wave modelling based on data acquired on a single stormy day occurred during the acquisition/monitoring period of oceanographic parameters. This is the most interesting and technically-sound part of the paper that would need further improvement to become the essential core of the paper, also to explain how the topo-bathymetric data have been used and integrated in the model, a feature which is currently lacking. In general, very little or none is explained on the creation of the seamless topo-bathymetric DTM which is rather crucial in the objective of building a flooding prevention model in the future. I do not see any significant discussion about the reliability, applicability and replicability of the experiment/surge model other than some considerations on the local level. This is something that is required by the mission of the ESSD journal. Finally, there is significant discrepancy between accuracy, detail and algorithms provided for the calibration and validation of the oceanographic data compared to the topo-bathymetric data.

As detailed in our response to specific comments hereinafter and in the revised manuscript, we elaborate on methodological aspects related to the building of the topo-bathymetric DTMs and its integration in the models. We further share reviewer's view regarding the modelling perspective for the development of an operational local flooding forecast system, but this paper focus on the acquisition and processing of topo-bathymetric and hydrodynamic dataset. Indeed, it occurs that this task precisely remains poorly documented whereas it is an essential prelude to the implementation and Calibration/Validation of the modelling tool. The subsequent modelling task are subject to ongoing efforts, which fall beyond the scope of this study.

Specific comments : The manuscript is pervaded by the use of terms and terminology that is hardly reconcilable with their common use or meaning and that prevent a fair and conscious assessment of the quality of the data and results provided by the Authors. Certain paragraphs are probably more verbose than necessary if exact terms would be used instead of the lengthy and approximate phrasing. This refers mostly to chapter 2.

We made efforts to improve the phrasing of the manuscript, as you will see in the Track Changes version. We have also reduced the use of synonyms for sake of clarity and consistency between text and figures.

Paragraph 2.2.2 "conflict resolution" sounds odd. As far as I understand, this can be described as a routine of prioritization based on a data quality index of the datasets. In the end, it appears hard understanding what kind of procedure has been used by the Authors and how much operator-based choices have been made, leaving the exercise almost not replicable to another dataset and therefore highly specific to the case study.

The so-called "Téthys" compilation process is quite technical. A description of the procedure can be found in (Le Deunf et al., 2023), we therefore do not further detail it in the manuscript, but proceed to some modifications on the terminology in section 2.2.2 for clarity and to ease reproductibility.

2.2.2. Data compilation

Selecting the most reliable source from multi-temporal and multi-sensor data is a fundamental challenge addressed in numerous works (Macnab and Jakobsson, 2000; Wong et al., 2007; Maspataud et al., 2015). This is particularly true for hydrographic offices, such as the Shom, which have a considerable legacy of data. Bathymetric data has been collected using several sounding methods with specific characteristics of accuracy and precision. Moreover, the data may span decades, introducing temporal and geomorphologic change as a source of error (Eakins et al., 2011). Due to the scarcity and the difficulty of collecting bathymetric data, TBDTMs are produced from a process of data compilation. This process, also known as "deconfliction", aims *to ensure that the most relevant sources are selected to create the best possible representation. Until now, this tedious process was carried out manually in accordance with the S-44 standard and survey specifications (Maspataud et al., 2015; IHO, 2017). To make it more efficient, Shom initiated in 2019 the Téthys project (Figure 2). This in-house project aimed at constituting Shom's bathymetric reference layer for which source data have been selected in order to generate the most accurate and up-to-date surface, satisfying the criteria related to the safety of navigation (Le Deunf et al., 2023). Overlap conflicts between surveys are resolved by a set of decision rules exploiting metadata (e.g. date, density, uncertainty and IHO order) which define if a survey supersede or complete older ones (Figure 2.b). In case of a survey with a "supersede" status, the deconfliction process is executed by clipping the bounding polygon of the reference survey to all other older overlapping surveys. No clipping is done for surveys with a "complete" status (Figure 2.b). The resulting layer will be regularly updated on the basis of newly integrated surveys (Figure 2.c).*

The paper would highly benefit from a clarification of what the Authors intend to be hydrographic data / hydrographic survey versus bathymetric data/surveys, the data presented are the measure of bathymetry sometimes acquired according to hydrographic standards.

Thanks for pointing this out. Compared to bathymetric surveys, when the term hydrographic survey is used, it refers to the study of bathymetry according to hydrographic standards, and may include other objectives such as the study of tides, currents, swell, water properties or the seabed. For sake of clarity for the reader, we finally replaced the hydrographic term by bathymetric term when talking about surveys or data.

L173 What do you mean by the inherent criteria of the data? Why criteria?

This sentence was about to explain that additional surveys followed the same deconfliction procedure based on their metadata (Thétys), but has finally been removed for clarity.

L172 What are the GMT routines (I assume you mean GMT mapping tools) used to de-conflict or to prioritize?

Indeed, we used the modules available in GMT 5.1.1 (Wessel et al., 2013). The "gmtselect" module is mainly used for this step (by using the polygon of the replacement surveys). We also use other modules that are well known to the community. This point has been clarified and the reference to GMT has been added.

The deconfliction process was executed on all datasets used for the generation of the TBDTMs using routines based on modules (selection, filtering, masking, merging) available with GMT 5.1.1. (Wessel et al., 2013).

L177 What do you mean by honouring variable density data?

Thanks for pointing this out, the sentence was reworded.

Splines functions are generally used for their efficiency when data densities vary. They produce a representative smooth and continuous surface.

LL182-185 I would like to hear more about the different altimetric models developed by SHOM.

Some details and additional references can now be found in section 2.2.4.

Following NOAA's previous works (Eakins and Taylor, 2010; Eakins et al., 2011), different datum alti-

metric grids were developed by Shom to convert the TBDTMs from the ellipsoid to other tidal datums (Lowest Astronomical Tide and Mean Sea Level). The creation of vertical reference surfaces at sea, linked to the ellipsoid, was initiated for the metropolitan french territory with the "BATHYELLI" project (Pineau-Guillou and Dorst, 2013). The surface realizations used to convert TBDTMs correspond to the propagation of a vertical sea reference to all points in a tidal zone, using a tidal model and a concordance equation.

L188 DTM coherency? This looks to be a manual depth validation process of the DTM based on the identification of artifacts or steps between adjoining surveys, it is a visual and qualitative assessment.

Indeed, we clarified the sentence accordingly.

The various checks carried out on the Téthys layer (reliability of attributes and bounding polygons, spatial coherence...) provide a robust data compilation from which the bathymetric surface is modeled. The DTM is also evaluated with qualitative and visual inspection (slope, cross-section and 3D views) and through additional layers (density, sources diagram).

L196 Oscillation effects, topographic creep? These are unusual and awkward ways of describing some interpolation artefacts, I barely understand their intended meaning.

Thank you for pointing this out, we have clarified the terminology and the description of this artefact.

Therefore, the survey with the strongest TVU is clipped to generate a coherent surface. An erroneous representation of depth can occur when three-dimensional data are far away, especially in unsurveyed marine areas (Eakins and Grothe, 2014; Danielson et al., 2016). In this configuration, the optimal fit of the B-spline multilevel model is not sufficiently constrained, the least-squares minimization is ill-posed and the resulting model can generate unwanted oscillations. Locally, these artifacts are minimized by increasing tension factor to smooth the surface.

L216 incident wave fields?

We changed it to *the offshore wave fields*.

Paragraph 41.1 is a description of the main oceanographic parameters recorded during the monitoring period between November 2018 and March 2019, which is very interesting from a scientific local perspective but poorly related to the building of the surge model. Furthermore, the observational period did not include any coastal flood event.

We believe it is crucial to associate field measurements to the development of the coupled surge/wave model for understanding and identifying key processes at play as well as for the calibration/validation of the model. Section 4 aims at bringing some insights on the benefits of such hydrodynamic dataset. For instance, despite the fact that the period of measurements did not encompass any flood event, the wave setup, that is found negligible at high tide, is unlikely a dominant process responsible for flooding, which precisely occurs at high tide with high tidal coefficients. Some modifications have been made in section 4 to clarify the objectives of this part.

References

Bonnot-Courtois, C., 2002. Bay of Mont-Saint-Michel and the Rance Estuary: Recent Development and Evolution of the Depositional Environments. volume 26. Editions Technip.

Couderc, F., Duran, A., Vila, J.P., 2017. An explicit asymptotic preserving low froude scheme for the multilayer shallow water model with density stratification. Journal of Computational Physics 343, 235––270.

Duran, A., Vila, J.P., Baraille, R., 2020. Energy-stable staggered schemes for the shallow water equations. Journal of Computational Physics 401.

Eakins, B.W., Taylor, L.A., Carignan, K.S., Kenny, M.R., 2011. Advances in coastal digital elevation models. Eos, Transactions American Geophysical Union 92, 149–150. URL: https://doi.org/10.1029/2011eo180001, doi:10.1029/2011eo180001.

IHO, 2017. IHO Standards for Hydrographic Surveys (Edition 5, 2008). Technical Report. IHO. URL: https://iho.int/uploads/user/pubs/standards/s-44/S-44_5E.pdf.

Le Deunf, J., Schmitt, T., Keramoal, Y., Jarno, R., Fally, M., 2023. Automating the management of 300 years of ocean mapping effort in order to improve the production of nautical cartography and bathymetric products: Shom's téthys workflow. Geomatics 3, 239–249. URL: https://doi.org/10.3390/geomatics3010013, doi:10.3390/jmse8110847.

Marsaleix, P., Michaud, H., Estournel, C., 2019. 3d phase-resolved wave modelling with a non-hydrostatic ocean circulation model. Ocean Modelling 136, 28–50. URL: https://www.sciencedirect.com/science/article/pii/S1463500318302713, doi:https://doi.org/10.1016/j.ocemod.2019.02.002.

Maspataud, A., Biscara, L., Hébert, H., Schmitt, T., Créach, R., 2015. Coastal digital elevation models (dems) for tsunami hazard assessment on the french coasts, in: EGU General Assembly Conference Abstracts, p. 1590.

Pineau-Guillou, L., Dorst, L., 2013. Creation of vertical reference surfaces at sea using altimetry and gps, in: Reference Frames for Applications in Geosciences, International Association of Geodesy Symposia. URL: https://doi.org/10.1007/978-3-642-32998-2_33, doi:10.1007/978-3-642-32998-2_33.

Richard, G., 2021. An extension of the boussinesq-type models to weakly compressible flows. European Journal of Mechanics - B/Fluids , 217–240.

Wessel, P., Smith, W.H.F., Scharroo, R., Luis, J., Wobbe, F., 2013. Generic mapping tools: Improved version released. Eos, Transactions American Geophysical Union 94, 409–410. doi:https://doi.org/10.1002/2013EO450001.