Report 1

The revised manuscript still contains some typographical or format errors (such as the position of some new references), which I have highlighted for the authors' attention (see attached documents).

Additionally, there are discrepancies between the authors' responses and the revised manuscript in several sections, such as Section 2.2. It is important for the authors to ensure alignment between the provided answers and the actual content of the manuscript.

Also, from my point of view key information, such as the proportions of training and validation samples, should be included directly in the main text to improve clarity and avoid reliance on external publications. Furthermore, the authors should clarify whether the rockfall source area map produced using the probabilistic LANDSUITE approach was satisfactory, providing evidence to support this assessment.

Finally, the authors are encouraged to incorporate the novelties described in their responses, such as the blue polygons and black dots in Figure 1, which are currently absent.

After addressing these few issues appropriately, the manuscript should be ready for publication.

We thank the reviewer for the comments, which were helpful and valuable to improve the manuscript. In the following, we answer one by one to the reviewer comments highlighting the changes done in the manuscript.

Comment 1
Round 1 Comment
In section 2.2 the authors list some sources of information used to define rockfall source areas, among which there is something cited as "some geomorphological information". I find this phrase too ambiguous and it should be more specific. What exactly did they use?
Round 1 Answer
We have modified the text in the first paragraph of the section 2.2 to explain which information we have used, namely landform features derived from DEM analysis with Geomorphons approach (Rossi et al., 2020).
Round 2 Comment
This is not included in the final version I received.
Round 2 Answer
We apologize for the error. In the first paragraph of section 2.2, the reviewer can find the general information used to define rockfall source areas. We have included additional explanations in the second paragraph, where it better explained the data used for the identification of the $PROB_{RSA}$ *(iii) probabilistic identification ($PROB_{RSA}$) together with the location of source areas exploits the following additional geo-environmental information as conditioning factors: topography parameters (i.e., slope, curvature, and aspect derived from the DEM), lithology and presence of dikes (Rossi et al., 2020).*

Comment 2
Round 1 Comment
In section 2.2 there is the weak point of the paper. If I have well understood, some crucial steps of the analysis are dependent on the available rockfall inventory. For instance, the ECDF model is built on data obtained within the mapped source areas; so is for the training and validation of the probabilistic model (logistic regression); and the supervised classification approach is fed by the rockfall deposition zones previously mapped. Notwithstanding, the only information provided about such an inventory is that they are "areas affected by rockfalls where we have identified detached boulders by field investigation". It is not clear if source areas and deposition areas are independent

polygons or not. There is no extra information about the number of the mapped rockfalls and the period in which the field survey was carried out. Furthermore, later in section 3.4 the authors mention two different inventories, but there is no information about what the origin of these data is. In my opinion this is one thing to be improved in the revised version.

Round 1 Answer

We have modified as follow, section 2.2 and Figure 1 to explain better the information available for the area that was used to identify the source areas, train and validate the runout and susceptibility modelling. [.....]

Round 2 Comment

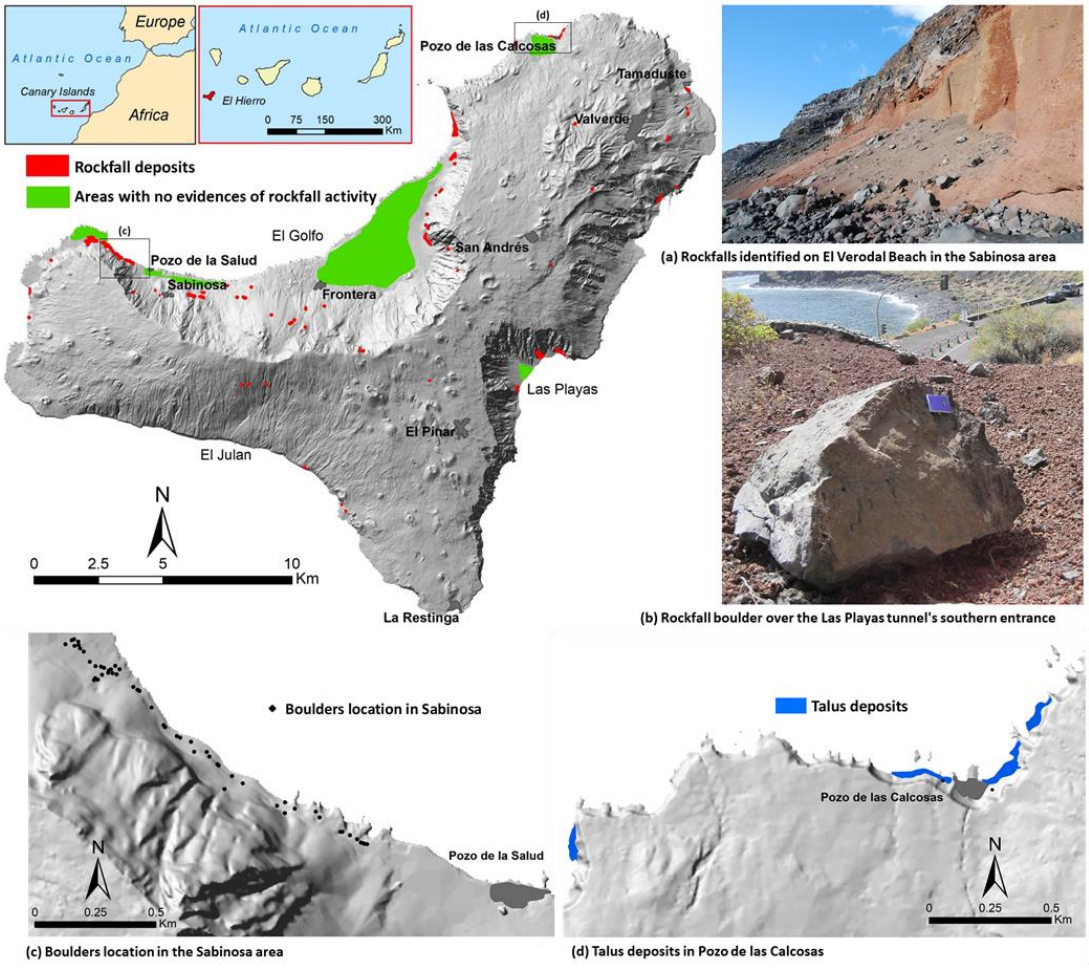
In the revised version of the manuscript downloaded from the application, this section does not appear to have been modified as described in the authors' response document. Similarly, Figure 1 does not reflect the stated updates, as the blue polygons and black dots mentioned in the response are absent.

Round 2 Answer

In the last paragraph of Section 2.2, we have modified/added text explaining the data types and methods used to collect rockfall information.

The rockfall information used in the runout simulations classification and validation was derived using diversified techniques and source of information. With field investigations conducted from 2012 to 2018 (47 records), aerial images interpretation (84 records), and using data from the MOVES database (BDMoves, 2024) (78 records), we have identified rockfall deposits (red polygons in Figure 1), which include single detached boulders (i.e., mapped as points; black dots in Figure 1c) and talus deposits (i.e., mapped as polygons; blue polygons in Figure 1d). Additionally, areas with no evidence of rockfall activity were recognized in the field by experts with the support of geomorphological and topographical maps (i.e., green polygons in Figure 1).

We have also modified Figure 1 as shown below.



Comment 3
Round 1 Comment
In section 3.1.3 there are some confusing explanations. It is not clear if the probabilistic model has been done merging the three outputs of the logistic regression, discriminant analysis and quadratic analysis; or instead, the authors just selected the better performing among them. Another important information is missing: the training and validation sample proportions. For the sake of the comprehensiveness of the paper I suggest to improve this section and to provide more details.
Round 1 Answer
The following text has been modified/added in section 3.1.3: The final source area zonation was prepared applying a combination of different statistical modelling methods, namely a linear discriminant analysis, a quadratic discriminant analysis, and a logistic regression model. See Rossi et al. (2022) for the details on training/validation/combination procedure.
Round 2 Comment
In my view, the proportions of training and validation samples are sufficiently relevant to warrant inclusion in the main text, sparing the reader the need to consult another publication to obtain this information. I recommend that the authors add a brief sentence to address this point.
Round 2 Answer
We appreciate the reviewer's comment. We have added the following sentence to address this point. *Four scenarios were evaluated, incorporating variations in training and validation areas, as well as the inclusion of active source areas (areas with recent geomorphological evidence of rockfall detachments) and prone areas (geologically and geomorphologically susceptible to rockfalls, but lacking recent detachment evidence). The optimal scenario involved model training using data from four fieldwork sites (Sabinosa, El Golfo, Las Playas, and La Estaca), with validation applied to the entire island. This configuration achieved the best performance, with an accuracy of 91.28% in training and a small difference in validation (2.68%), as well as an AUCROC of 0.954, the highest among all scenarios. Therefore, the source map obtained using this scenario stands out as the most consistent model, delivering the best performance in island-wide validation.*

Comment 4
Round 1 Comment
In section 4.1 I was expecting the validation results of the probabilistic approach applied to generate the PROBRSA map, since in section 3.1.3 the authors state that "Specifically, contingency matrices and plots along with model sensitivity, specificity, Cohen's kappa indices and ROC curves with the corresponding area under curve (AUCROC) values, were used to compare the observed and modelled source areas and to explore quantitatively the performances of different model configurations allowing the selection of the best model and the corresponding probabilistic source area map". In my opinion these are very relevant results that need to be shown up.
Round 1 Answer
In the article "Probabilistic Identification of Rockfall Source Areas at Regional Scale in El Hierro (Canary Islands, Spain)" by Rossi et al. (2020), all the methodologies and results to generate probabilistic RSA are explained in detail, including contingency matrices and plots along with model sensitivity, specificity, Cohen's kappa indices, and ROC curves with the corresponding area under the curve (AUCROC) values. We have chosen to not repeat such information in this article that illustrates several methodologies to derive rockfall susceptibility zonation. We have indicated more clearly in 3.4 the reference where is possible to search such information. We additionally provided a summary in section 3.1.3 and a reference the previous one for further information on the probabilistic source area map.

Round 2 Comment
As the authors are undoubtedly aware, the production of a rockfall source area map using a probabilistic approach, such as LANDSUITE, can yield results that vary in quality. I maintain that the authors should explicitly clarify whether the obtained map was deemed satisfactory and provide supporting evidence for this assessment within the text. It shouldn't be more than one or two extra lines.
Round 2 Answer
Many thanks for your comment. We have added the following sentence in section 3.1.3: *This configuration achieved the best performance, with an accuracy of 91.28% in training and a small difference in validation (2.68%), as well as an AUCROC of 0.954, the highest among all scenarios. Therefore, the source map obtained using this scenario stands out as the most consistent model, delivering the best performance in island-wide validation.*

Comment 5
Round 1 Comment
I strongly suggest improving the writing of Section 4.2. The argumentation was difficult to follow. Since this section discusses the core results, it is important to present it as clearly as possible. Therefore, I recommend dedicating additional effort to ensure clarity in this crucial part of the manuscript.
Round 1 Answer
Many thanks for your suggestion. Section 4.2 have been improved to facilitate understanding. [.....]
Round 2 Comment
Once again, the text provided in the response does not align with the content of Section 4.2 in the revised manuscript. In this case, I find the version in the manuscript to be more effectively written.
Round 2 Answer
Thanks for your correct comment. As you pointed out, the final and correct version of the resubmitted section 4.2 was not aligned with the response file.

Comment 6
Round 1 Comment
Section 5 correctly synthesizes the presented results and draws conclusions that are well supported by the evidence. However, to enhance this section, I would appreciate a more in-depth discussion on the implications of the findings. For instance, does this mean that every rockfall susceptibility analysis should utilize the PROBRSA approach for identifying source areas, in combination with STONE and the ECDF classification method? Additionally, while STONE, like many other rockfall simulation software mentioned by the authors, is effective, it does not account for certain relevant factors in fall trajectories, such as the initial size of the detached boulder or other complex mechanical aspects. A brief discussion of the limitations and advantages of this tool would be valuable for readers to consider.
Round 1 Answer
The authors welcome your suggestion for a more comprehensive discussion on the implications of the findings. We have added the following text. [.....]
Round 2 Comment
The text provided here differs slightly from the version in the revised manuscript. However, in this case, the manuscript version adequately meets the requirements.
Round 2 Answer
Thanks for your correct comment.

Comment 7
Round 1 Comment
Page 7 – Line 203: "…the three source areas maps…" source area maps?
Round 1 Answer
Done
Round 2 Comment
It hasn't been corrected in the rest of the manuscript and figures
Round 2 Answer
Sorry for the mistake. It has now been corrected in the manuscript.

Comment 8
Round 2 Comment
Rockfall
Round 2 Answer
We were referring to the RocFall software developed by Rocscience. We have now corrected the word. (https://www.rocscience.com/software/rocfall).

Comment 9
Round 2 Comment
discontinuous
Round 2 Answer
Done. We have changed the word.

Comment 10
Round 2 Comment
For El Hierro island the following data are available:
Round 2 Answer
Done.

Comment 10
Round 2 Comment
Suggestion. Move Table 1 to the end of the next paragraph.
Round 2 Answer
Done.

Comment 10
Round 2 Comment
Suggestion. Move Table 1 to the end of the next paragraph.
Round 2 Answer
Done.

Comment 11
Round 2 Comment
Reference
Round 2 Answer
▪ We have checked and corrected the reference format and position Instituto Canario de Estadística, ISTAC: http://www.gobiernodecanarias.org/istac/ (last access: 5 December 2022), 2022. ▪ Centro de Descargas del CNIG (IGN): https://centrodedescargas.cnig.es/CentroDescargas/index.jsp (last access: 09 May 2024), 2024. ▪ BDMoves: http://info.igme.es/BD2DMoves/ (last access: 14 May 2024), 2024.

Report 2

The manuscript is currently undergoing a "major revision" process, and I sincerely acknowledge the authors' efforts to address previous reviewer comments and improve certain sections.

However, considering all these efforts, I must state that the paper still faces significant challenges in demonstrating sufficient novelty. The methods applied have already been used in the same study area, and apparently, no new datasets have been introduced to advance the state of knowledge. Additionally, the frequent references to the authors' previous work diminish the standalone value of the current study, making it heavily reliant on prior publications. Consequently, the only new contribution is the comparative analysis.

Unfortunately, the relevance and impact of this comparative analysis are limited. The presentation of results raises some questions, partly due to the inconsistent introduction of methods and the superficial description of workflow steps and data used. Moreover, the study lacks a robust uncertainty assessment, which is essential for convincingly demonstrating the advantages or broader applicability of the proposed approaches. The conclusions remain overly general and fail to provide significant novelty or actionable insights.

While portions of the paper are well-written, some statements are overly simplistic and require greater precision and clarity. Inconsistent usage of established technical terminology in the text should also be addressed to ensure coherence and improve the overall quality of the manuscript.

The authors should consistently use established terminology to strengthen the paper, provide a more detailed and transparent presentation of the methods and data, and streamline the workflow with clear and consistent definitions of its components (e.g., susceptibility analysis and runout zonation). Additionally, the discussion should include a rigorous assessment of uncertainties and present a more explicit interpretation of the results. Addressing these issues, the paper could add value as a rigorous and insightful case study.

We thank the reviewer for the comments, which were helpful to improve the manuscript. In the following, we answer one by one the comments highlighting the modification done in the manuscript. We have modified the manuscript mainly explaining the novelties introduced by the study, correcting some inconsistencies in the use of terminology and adding details and a figure to improve the workflow description.

Comment 1
Round 2 Comment
"I must state that the paper still faces significant challenges in demonstrating sufficient novelty."
Round 2 Answer
Regarding this point, the main novelty of this work is the proposal of a systematic workflow that integrates (i) source area identification, (ii) deterministic runout modelling, (iii) the classification of runout outputs to derive susceptibility zonation, and (iv) robust procedures for validation and comparison. Indeed, in the literature there are articles mainly focused on singular aspects of rockfall modelling (for instance on source areas identification, rockfall runout or susceptibility zonation), but only few investigate how the definition of source areas influences rockfall simulation and the susceptibility zonation. The proposed approach enables the integration and comparison of different modelling, introducing a robust and consistent workflow/methodology that allows to derive and verify rockfall susceptibility zonation considering different steps. Parts of the entire proposed workflow exploit well known tools/approaches (e.g., use of STONE), others introduce new aspects/tools of the modelling (e.g.,

use of ECDF for source area identification, proposal of criteria to translate trajectory counts to susceptibility probabilistic zonation).
To clarify the novelty of the study, we have modified/added text as follow.

The abstract was largely modified and rearranged.

In the Introduction we added test to clarify terminological and literature background and to better explain the proposed workflow.
See revised text from lines 50 to 66 and from 114 to 128.

In the methodology, we modified the general description, and we added a new figure (Figure 2).
See revised text from lines 187 to 202.

In Discussion and conclusion, we reorganized and modify the text to improve the description of the proposed workflow, and its results obtained in the study area.
See revised text mainly from lines 430 to 475.

Comment 2
Round 2 Comment
"Inconsistent usage of established technical terminology in the text should also be addressed to ensure coherence and improve the overall quality of the manuscript" *"The authors should consistently use established terminology to strengthen the paper"*
Round 2 Answer
We thank the reviewer for the comment. In response, we have added a paragraph in the introduction where we present the terminology used in the manuscript. Additionally, in the flowchart, we have emphasized and harmonized each of the terms. Lastly, we have reviewed the text to get consistency in the terms used. See the previous comment.

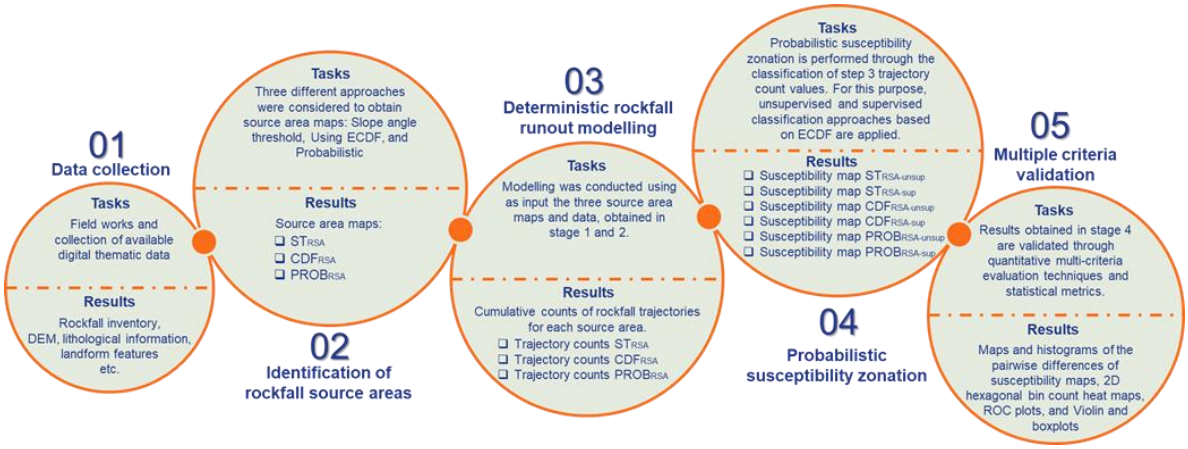
Comment 3
Round 2 Comment
"provide a more detailed and transparent presentation of the methods and data, and streamline the workflow with clear and consistent definitions of its components (e.g., susceptibility analysis and runout zonation)."
Round 2 Answer
We thank the reviewer for their comment. In section 2 we added a more detailed description on data. *The rockfall information used in the runout simulations classification and validation was derived using diversified techniques and source of information. With field investigations conducted from 2012 to 2018 (47 records), aerial images interpretation (84 records), and using data from the MOVES database (BDMoves, 2024) (78 records), we have identified rockfall deposits (red polygons in Figure 1), which include single detached boulders (i.e., mapped as points; black dots in Figure 1c) and talus deposits (i.e., mapped as polygons; blue polygons in Figure 1d). Additionally, areas with no evidence of rockfall activity were recognized in the field by experts with the support of geomorphological and topographical maps (i.e., green polygons in Figure 1).*

To clarify the workflow followed, we have expanded the methodology changing the general description, and adding a new figure (Figure 2).

The methodology proposed in this study can be formalized in a workflow that consider different steps (Figure 2).

1. *The first step is typical of any rockfall study, where relevant available data is collected (e.g., field surveys, photo-interpretation, etc).*
2. *The second step focuses on the identification of rockfall source areas, a critical input for the subsequent analyses performed using different approaches.*
3. *The third step is the deterministic rockfall runout modelling using taking as input source areas of step 2. The main output is a map of the cumulative count of rockfall trajectories.*
4. *The fourth step derives probabilistic susceptibility zonation through the classification of trajectory counts values of step 3. Unsupervised and supervised classification approaches, based on the Empirical Cumulative Distribution Function (ECDF), are applied for the purpose.*
5. *The fifth step validates and verifies the susceptibility maps and assesses the reliability of susceptibility zonation, using quantitative multi-criteria evaluation techniques and statistical metrics.*

The five methodological steps, their application in the study area and the results are illustrated in the following sections.



Comment 4
Round 2 Comment
"the discussion should include a rigorous assessment of uncertainties and present a more explicit interpretation of the results. Addressing these issues, the paper could add value as a rigorous and insightful case study."
Round 2 Answer
In Discussion and conclusion, we reorganized and modify the text to improve the description of the proposed workflow, and its results obtained in the study area. See revised text mainly from lines 430 to 475. Regarding the uncertainty, we acknowledge that we didn't structure the analyses to estimate uncertainty with a classical transfer chain approach, but the main and more relevant sources of uncertainties are identified and discussed in the manuscript. We maintain that the source areas identification comparisons and all the relative results and analyses should be considered as ways to investigate some of the potential uncertainty in the proposed rockfall modelling methodology.

To emphasize these aspects, we added comments in the text on the probabilistic source areas ($PROB_{RSA}$) model training and relative ROC results and we added comments on the violin plot analysis (Figure 11 in the revised manuscript).