Reviewer #2

RC: *I have enjoyed reading this paper and believe it to be a valuable addition to the literature. As far as I am aware it is the first attempt to build a globally applicable landslide detection model using SAR data and deep learning techniques and the results look very promising. There are a few minor revisions that I think are needed before the paper can be published. The main one is the use of the Haiti earthquake as a test case – I am concerned that since the optical inventory was compiled after a tropical storm passed over the area, the landslides detectable in the SAR images acquired before this storm might not match the landslides mapped with the optical (see my comment on line 266 for more detail).*

AR: We thank the reviewer for the positive feedback and constructive comments. We agree that the Haiti case, as originally presented, may be biased because part of the mapped inventory includes landslides triggered by the tropical storm that followed the earthquake. To address this, and following your suggestion, we have redefined the post-event period to start after the storm (17 August) rather than immediately after the earthquake. In addition, as also noted by Reviewer #1, we have created a new polygon-based inventory from post-event Sentinel-2 imagery acquired on 1 January 2022 to enable quantitative evaluation. We report the updated results in the revised version of Figure 4 and include the corresponding quantitative metrics for both the Haiti and Sumatra events in response to specific technical comments below.

RC: *Line 55 "the issue of transferability in different settings and with different satellite data persists" you have addressed the first part, but since you only use Sentinel-1, the second limitation remains.*

AR: We agree. Since we only use Sentinel-1 data, that part of the sentence was misleading. We will remove "and with different satellite data persists" so that the statement will only refer to transferability (more aptly to 'generalizability') across different settings.

RC: *Line 59 "Instances where SAR and DL are combined remain rare." This is true, but there are a few more examples you could include*

1. *Liang et al. (2025) use deep learning with polarimetric ALOS-2 SAR data to detect landslides - although the requirement for quad-pol SAR makes their work less widely relevant than yours since such images are not available for many earthquakes https://doi.org/10.1016/j.rse.2025.114904*
2. *Chen et al. (2024) use deep learning for landslide detection with Sentinel-1 images https://doi.org/10.1080/17538947.2024.2393261*

Then there are several studies using more basic machine learning methodologies that may or not be relevant here

1. *Ohki et al (2020) use Random Forests with SAR and terrain variables for landslide detection for two events in Japan https://doi.org/10.1186/s40623-020-01191-5*
2. *Burrows et al. (2021) use Random Forests with SAR and attempt a somewhat "global" model, although it only includes 3 events https://doi.org/10.5194/nhess-21-2993-2021*
3. *Lin et al. (2021) use Object based image analysis and SAR images for landslide detection 1109/IGARSS47720.2021.9554248*

AR: We thank you for these suggestions and we consider all these citations relevant for our paper. We will therefore add them in the introduction. Please refer to the same and the Reference section for confirmation (once we upload the revised manuscript).

RC: *Line 76 "across diverse geographic and geologic settings". The majority of your events are in vegetated areas and you do not include any cases where snowfall might complicate your signal (e.g. the 06/02/2023 Turkey earthquake.*

AR: We agree with this notion. This limitation is acknowledged in the manuscript (Discussion - gap analysis section), so no changes were made.

RC: *Line 127 "Notably, Sentinel-1b has been inactive since 2022 and it is in the process of being substituted by an equivalent platform" Sentinel-1c has been launched since you originally submitted this manuscript so you could update this sentence.*

AR: Thank you, we agree. We have updated the sentence. It now reads: "*Sentinel-1B has been inactive since 2022 and is now being replaced by Sentinel-1C, which was successfully launched and will ensure continuity of C-band SAR acquisitions.*".

RC: *Line 172 "side of look" "Look direction" is more commonly used for this.*

AR: Thank you for the suggestion and we agree. We have revised the paragraph for clarity, and in the updated version we no longer explicitly mention "*side of look*".

RC: *Line 177 The GEE script by Vollrath 2020 also carries out radiometric terrain correction converting from sigma0 (normalised in the ellipsoid plane) to gamma0 (normalised in the plane perpendicular to the local satellite look direction) did you also carry out this processing step on your data? Or did you only use the shadow and layover mask?*

AR: Thank you for this comment. We just used the shadow and layover masks from that code, so no conversion to gamma0 was made.

RC: *Line 178 "inventory filtered with ascending/descending distortion masks". It would be useful to know how much of each study area is masked (could be as a supplement rather than in the main text)*

AR: We agree that knowing the proportion of each study area masked would add useful context. Unfortunately, calculating this would require re-running the entire processing chain, which is not feasible within the scope of the current revision. What we can do, however, is add a clear statement in the text about this limitation and, where possible, provide approximate values or qualitative indications based on representative examples. We hope this will address the concern without requiring a full reprocessing of the dataset.

RC: *Line 212 "VH data is not available for these three locations" as far as I know, VH data was not regularly acquired until late 2016, so this will not be a problem for any future events you applied your model to.*

AR: Yes, we agree. This limitation mainly affects the three events in our dataset (Capellades, Kaikōura, and Gorkha). However, evaluating model performance with VV-only data provided useful insight into the added value of including multiple polarizations when available.

RC: *Figure 3 It is quite hard to see the blue boxes overlying the grey images. Maybe they could be a brighter shade like cyan.*

AR: Thank you for the suggestion. We have adjusted contrast to improve visibility in Figure 3. We'll share this in the revised manuscript.

RC: *Line 266 "The Haiti case is particularly challenging due to its topographical and environmental variability". Another reason Haiti is challenging is that it was followed a few days later by a tropical storm. Studies of this event noted that many landslides increased in size during this storm (making them easier to detect using your SAR methods) (e.g. Havenith et al. 2021 https://doi.org/10.5194/nhess-22-3361-2022).*

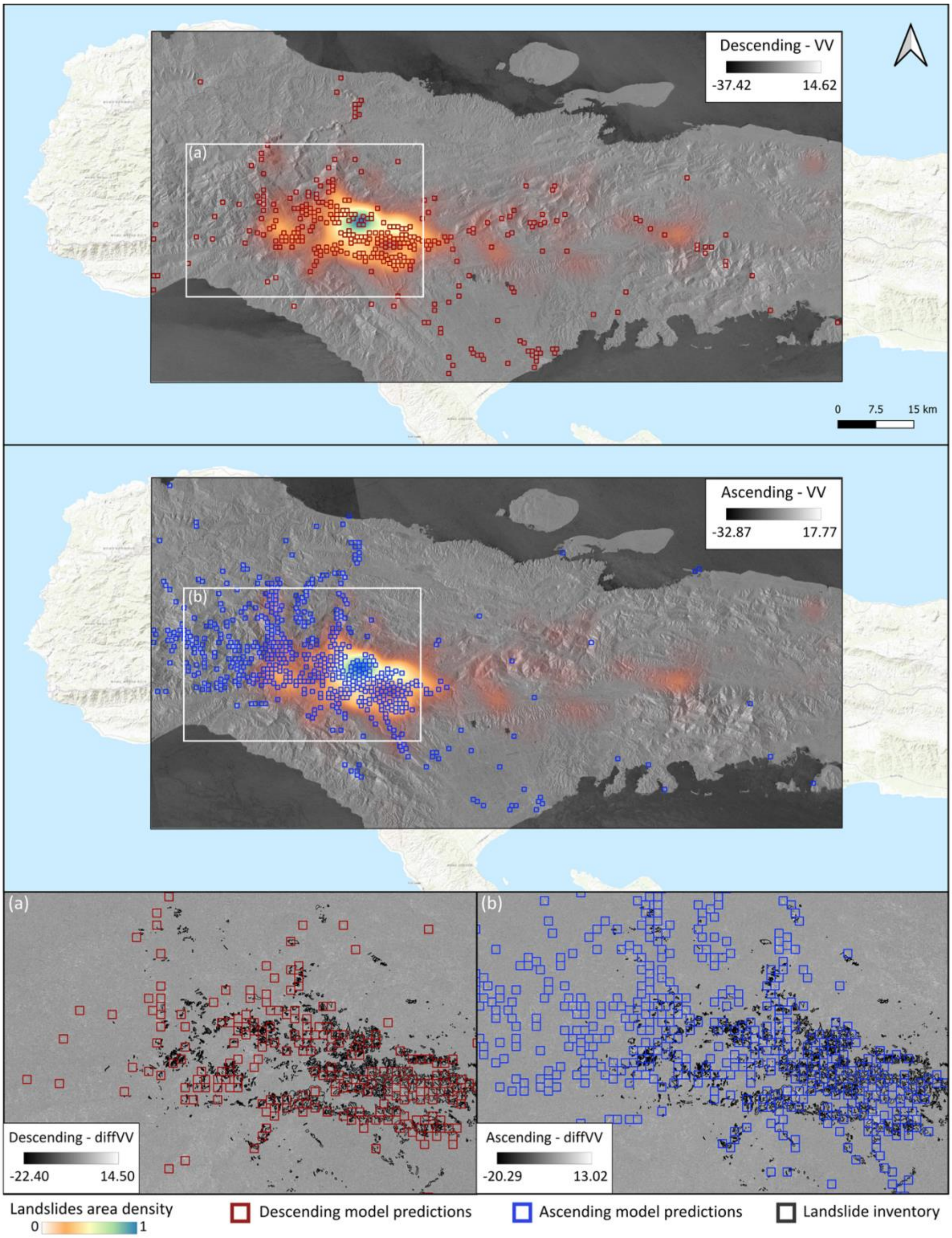
The exact images used to compile the inventory are not given in the inventory of Martinez et al., but in a different study on this event, Havenith et al. (2021) state that only 10% of the study area is visible in images acquired between the storm and the earthquake, so it can be assumed that most of the inventory is done using images acquired after the storm. The inventory includes both earthquake-triggered and storm-triggered landslides.

On your ascending track, the first post-seismic SAR image was acquired after the storm so also includes both earthquake- and storm-triggered landslides. However, on the descending track, the first post-seismic SAR image was acquired before the storm and so only includes earthquake-triggered landslides.

In my opinion, it would be better to consider the earthquake and storm as a single trigger and so start the period for your post-event stacks on the 17th of August (when the storm passed over) rather than on the 14th (when the earthquake occurred). Otherwise you are comparing earthquake and storm-triggered landslides in the optical imagery with earthquake-triggered landslides only in the descending-track SAR image.

AR: Thank you for this comment and for pointing us to Havenith et al. (2021). We agree that the overlap between earthquake- and storm-triggered landslides complicates the interpretation of the Haiti case, especially given the differences between ascending and descending track acquisition dates. Following your suggestion, we re-run the experiments starting the post-event stacks after 17 August (after the storm).

In parallel, we designed a new polygon-based inventory using Sentinel-2 imagery (images acquired on 1st January 2022). This allowed us to improve the qualitative evaluation of the predictions (we compare the predictions of the models with a landslide area density heatmap (see the figure below which will replace Figure 4 in the paper), and also to derive quantitative performance scores.



RC: *Line 272 Define the acronym SHAP.*

AR: We now define SHAP in the text as SHapley Additive exPlanations when it first appears.

RC: *Line 287 "Moreover, our model's performance does not improve with an increase in the number of pre-event temporal stacks, contrasting with findings reported by Handwerger et al. (2022)" Maybe this depends on which events are used as test cases? For example if the landscape experiences widespread snowmelt during springtime in the 2 months prior to an earthquake, then using a full year of amplitude data would be beneficial to mute this signal.*

AR: Yes, we agree this is a plausible explanation. Identifying the exact cause would require additional testing, but we acknowledge in the revised text that using a longer pre-event time series could be beneficial in cases with strong seasonal changes, such as snowmelt.

RC: *Line 289 "Increasing the difference between pre- and post-event stacks" it would be clearer to say "increasing the difference in size between pre- and post-event stacks".*

AR: Thank you. We have updated the text.

RC: *Line 323 "However, it is important to note that the location of landslide-related information in SAR imagery does not always align with the location of landslides in optical imagery due to geometric distortions, which is a current inherent limitation of SAR data" This is true, but optical images do not necessarily represent the "true" location of landslides while SAR images give a "false" one. Studies such as Pokharel et al. (2021) https://doi.org/10.1038/s41598-021-00780-y demonstrate that different inventories of the same event do not agree even when all the landslides are mapped using optical imagery.*

AR: Yes, we agree. We do not treat optical inventories as absolute ground truth but simply use them as a reference for comparison as they are the best available record when it comes to spaceborne based mapping. The sentence is intended only to explain the apparent shift between SAR and optical data in the figure, not to suggest that optical imagery is inherently the best.

RC: *Line 367 "160 SE" these are therefore slopes facing away from the SAR sensor – it would be useful to state this.*

AR: Thank you for this comment. This helped us catch an inaccuracy. These slopes do not face away from the SAR sensor but are closer to perpendicular to the Sentinel-1 descending look direction. We have corrected the text to reflect this and now explain that this near-perpendicular geometry likely reduces backscatter contrast, making landslides harder to detect. We thank the reviewer for helping us observe this inaccuracy.

RC: *Line 407 "generalized rapid co-seismic landslide detection" you should specify here "in vegetated areas" since you do not test your model on any earthquake in a more arid environment..*

AR: Thank you. We agree, and we will modify the text accordingly.

RC: *Typographic corrections.*

AR: We thank you for these suggestions. We'll modify the text accordingly.