Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2020-315-RC1, 2020

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Rapid landslide identification using synthetic aperture radar amplitude change detection on the Google Earth Engine" *by* Alexander L. Handwerger et al.

Anonymous Referee #1

Received and published: 26 October 2020

The Authors present a SAR amplitude change detection based tool to detect and map landslides events. The tool is implemented in Google Earth Engine and applied to Sentinel-1 imagery. The use of SAR amplitude for landslide detection has raised some interests recently, so as platforms for data pre-processing.

The manuscript is easy to read and 'pleasant' but somehow too vague in the description of some key concepts. in particular in the presentation of the algorithm (the tool can be easy to use, but the description of the variables and steps should be more detailed or rigorous).

Unfortunately, in my opinion, there is a main conceptual issue which does not allow

the Authors to obtain the result they want, and, as a matter of fact, invalidating the conclusions: the algorithm obtained the thresholds using an external inventory, without the inventory prepared by GSI, no thresholds, and no DEM mask. So the tool cannot be used to prepare inventories, without having already an inventory.

I then suggest to reject the paper for a methodological problem, and I encourage the Authors to review the research framework.

In detail:

Abstract

16 - triggering events because it penetrates clouds: probably referring to rainfall-induced events

16 - regularly acquired: this is true for S1, not sure it is true for other facilities.

25 – Not sure about the meaning of the entire sentence

1 Introduction

General question: are 'identify' and 'detection' synonyms? Since in the introduction also 'mapping' is mentioned, I suggest to define the terms, also because the first (wrong?) expectation I had was about a tool for mapping landslides (see row 35).

71-72 Our methodology. . .: actually it seems to me that you need to know that landslides occurred, and the changes were caused by landslides.

73 duration: also this point should be better clarified: how can I know a priori about the duration of the event? This can be 'simple' like in the test case, but how about landslides triggered by seasonal monsoons, or typhoons?

73 catastrophic: I suggest to cancel it.

2 Methods

92-93: it can be used for constructing landslide inventories with high accuracy, sounds

to me a bit vague. Does it mean that it produces high accuracy inventory or simply that it can contribute to? And, what does 'high accuracy' mean?

2.1 SAR amplitude-based Change Detection on Google Earth Engine

104 – 105 are processed to remove thermal noise and they are radiometric and terrain calibrated: sorry, unclear to me whether they are processed by your algorithm or that is the way images are available in GEE. In both cases, if radiometric calibrated, then it should not be amplitude but some backscatter coefficient, Sigma/beta/gamma_nought. Furthermore, what does 'terrain calibrated' mean? Orthorectified?

108 – 109 .. spatial resolution. . .: please check 25 x 25 (should be EW and not IW, but EW is not here used). Furthermore, I suggest you to explain why the two concepts (resolution and pixel spacing) are here both mentioned and what is the impact in the final maps of a spatial resolution of 20 x 22 m.

111 All S1 GRD amplitude values are provided in logarithm..: I guess this is something done during the pre-processing chain to stretch the values. And from here to the end, I think it is no more A but some backscatter coefficient (after radiometric correction)

116 a single landslide: again, the feeling I get is that we must already know that a landslide has occurred. . .

118 . . . will vary..: I suggest to provide better indications on how to select T in case of rapid identifications or inventory constructions.

120 we further reduced noise: Why further? Is it referred to the multi-look done during the pre-processing level to get GRD images? Actually what is done here sounds to me a bit weird. The stack can smooth the signal, but I am not sure that it works as a filter to remove the noise (which is multiplicative). I think the median can depend on many factors including seasonal variations, soil moisture (rain..). Is this one of the reasons for which it is better to use many images? If yes, it is not just a matter of number but also a matter of the variability experienced in the study areas. Furthermore, I'm

surprised that the different geometries can be combined without problems, in particular in mountainous areas. Another question: the pixels in ascending and descending after multi-look should follow different Gamma distributions, how they can be combined using the mean?

124 examining the change in amplitude: really too generic. Examining how? I think we should not wait for paragraph 2.1.

132 using threshold-based masks: again too generic. How did you obtain thresholds? Are the thresholds general, or tuned according to the test areas? What data do you need to obtain the thresholds?

2.1 SAR Change Detection Performance

138 -139 To test the performance of our SAR..: I think this is one of the main issues of this paper. This is not a comparison, actually the inventory is used to tune the thresholds. So, no external inventory, no product. . .

141 -143 We calculated detection performance: I disagree, you are tuning the model, looking for the best threshold

154: the thresholds used for slope angle..: again, this is possible only if the external inventory is available.

3 Test site

4 Results

4.1 Landslide Identification

General question: can the need of having such a large number of images be originated by the way that images are smoothed?

180 we compared: I am strongly persuaded that you did not compare but used the GSI inventory to obtain the final map

185 136 images: but this method should produce a product in one or two weeks. . .

192 the complete stack: again, the product should be obtained just after the event.

215 from the previous analyses: this means including false positives, I guess. Indirectly, the GSI inventory is used too. Also, thresholds obtained seem to be very conservative. . .

220-221: this sentence does not have much sense. Empirically but without a landslide inventory. . . Need for verification.

222 and Fig.3 a: it says that, definitely, the best results cannot be obtained after one or two weeks.

4.2 Landslide identification for rapid response

232 the DEM mask: if I understood well, the DEM mask was obtained using the best result obtained in the previous analysis, which means by using the multitemporal stack. Please clarify.

271 .. removed isolated pixels: how was 6 chosen?

277 farmlands: this is a consequence of using such a large T-pre, isn't it?

5 Discussion

294-295: to be consistent with your analysis, I suggest to say an amplitude decrease, or better, surface backscatter.

314 helps to reduce the noise: again, I suggest to say that it smooth the signal. (which is different from reducing the noise, in particular, the multiplicative noise in SAR images).

318 inconsistent: sorry I can't understand the concept.

324 Gaussian smoothing filter: pay attention because, after multi-looking, pixels do not normally distribute.

372-373: this is to be removed, or results should be presented in more detail.

6 Conclusions

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-315, 2020.