

## ***Interactive comment on “Comparison of event landslide inventories: the Pogliaschina catchment test case, Italy” by A. C. Mondini et al.***

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General Comments: This manuscript presents the basic idea of event-based landslide inventory preparation and the comparison of two inventories prepared through visual interpretation and semi-automatic classification. The topic apparently fits the interest of the journal and is suitable for publication in NHESD. The manuscript is well organized and structured, with well written English. Before it can be accepted by NHESD, clarification for some unclear descriptions regarding to the preparation of the two inventories, my major concern, is needed. Here I addressed specific comments and few technique corrections for this manuscript.

We thank Reviewer II for the positive comments.

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Specific Comments: **Á**

Does the paper address relevant scientific and/or technical questions within the scope of NHESD? Yes

Does the paper present new data and/or novel concepts, ideas, tools, methods or results? Yes. Generally speaking, the authors didn't apply new approaches in their landslide mapping. They focus on standard ways of preparing an event-based landslide inventory and try to evaluate the efficiency of the SA approach by comparing it with PI. Novel indices introduced in the study seem to be very useful for evaluating the difference/similarity of the two.

Are these up to international standards? Yes.

Are the scientific methods and assumptions valid and outlined clearly? Mostly yes. The authors consider the effect of shadow area on SA classification, which is technically reasonable if we assume all SA users have capability to fix the shadow problem. However, in many cases, a SA inventory is very possibly obtained without considering shadow effect that SA classification may produce a landslide map with lower quality. In this case, I suggest the authors should also highlight the consequence when shadow is not taken into consideration.

The presence of shadows together with clouds is probably the main problem in processing satellite images when landslide maps have to be prepared. In Italy the problem is severe because the main distributed landslide events likely to occur from October to February/March, then during the winter season when shadows affect our mountainous areas. In our case we were “lucky” because the scene was not completely dark and some radiometric signal was still trapped by the satellite sensor. We agree that different SA techniques or worse conditions could have affected the mapping. It would be interesting to establish the limits of the SA techniques in detecting landslides in shadowed areas (or how intense the shadows must be to make the SA useless), but we do not have enough statistic cases and this is out of the scope of this work. We

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(indirectly) considered the point in section 6 “Comparison of the two event inventories” where we removed the 74 landslides (14% of the total number of landslides mapped by the SA) mapped in shadowed areas, and we repeated the comparison of the two inventories. To consider the comment, we modified part of the discussion in: “The semi-automatic technique was able to detect landslides in shadow areas, exploiting the faint, but not completely missing, landslides radiometric signature captured by the multispectral satellite image. In the same areas, the visual interpretation of the aerial photographs failed to recognize some landslides, because the aerial imagery was too dark to allow for their visual recognition.”

Are the results sufficient to support the interpretations and the conclusions? Yes.

Does the author reach substantial conclusions? Yes.

Is the description of the data used, the methods used, the experiments and calculations made, and the results obtained sufficiently complete and accurate to allow their reproduction by fellow scientists (traceability of results)? In the PI inventory, four classes are included. They are: (1) translational slides, (2) earthflows, (3) soil slips and (4) rotational slides. I expect the authors to demonstrate how to classify these four classes from the photo. And for SA inventory, the authors should explain how they separate “soil slips” and other types of landslide.

We added the following explanation in Section 5.1: “Visual interpretation of the aerial and the satellite imagery was aided by field surveys aimed at making the interpreters familiar with the landslides and the landscape where the slope failures occurred, and to resolve local ambiguities and visual classification problems. Field surveys lasted about two weeks and were carried out during the weeks after the event and one year later, in the period between October 2012 and January 2013. With a maximum depth of two meters, all landslides were classified as shallow and grouped into four classes: (1) translational slides, (2) earth flows, (3) soil slips, and (4) rotational slides. Field surveys allowed recognizing the different types of landslides, and to collect soil samples

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to characterize residual soils in the landslide scarps. In the study area, translational and rotational slides are located mainly at the foot of slopes along main and secondary streams. Earth flows exhibit elongated shapes, are frequently channeled along secondary streams, and exhibit longer run out distances than the translational and the rotational slides. Lastly, soil slips are the first evolutionary stage of the other landslide types, and exhibit wide and irregular surfaces that are covered locally by grass and shrubs. Soil slips are abundant in terraced slopes, in low gradient areas where vegetation is scarce, in cultivated areas, and in abandoned cultivated areas. This finding is in agreement with the observations of other authors (Canuti et al., 2004; Conti and Fagarazzi, 2004; Tarolli et al., 2014) on the relevance of processes associated to agricultural land abandonment, including lack of maintenance of dry-stone walls in terraced areas and the clogging of minor drainage channels, on soil degradation and the initiation of shallow slope instability.”

In this specific case, the SA technique does not allow a classification of the detected landslides. This is a limitation of the technique, and it is discussed in the Discussion.

Does the title clearly and unambiguously reflect the contents of the paper? Yes.

Does the abstract provide a concise, complete and unambiguous summary of the work done and the results obtained? Yes.

Are the title and the abstract pertinent, and easy to understand to a wide and diversified audience? Yes.

Are mathematical formulae, symbols, abbreviations and units correctly defined and used? If the formulae, symbols or abbreviations are numerous, are there tables or appendixes listing them? In Eq. 1, the definition of “spatial landslide density” is not clear. In page 1099 line 13: please give full name of GIS (Geographic Information system).

We added the standard definition of spatial density tailored for landslides (if not it would

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be number of elements per unit area) in the brackets, and we added further explanation, now the sentence is: "We determined the spatial density of the event landslides (number of event landslides per unit area) in the two event inventories using a low pass Gaussian filter moved across the two landslide maps where the landslide presence is initially marked by the value one and landslide absence by the value zero."

We remind that the number is not necessarily an integer.

We changed GIS in Geographical Information System.

Is the size, quality and readability of each figure adequate to the type and quantity of data presented? Yes.

Does the author give proper credit to previous and/or related work, and does he/she indicate clearly his/her own contribution? Some citation mismatches can be found in the manuscript. For example "ISPRA, 2013" is not found in references.

The reference was added to the list of references.

Are the number and quality of the references appropriate? Citation mismatches should be fixed.

We have checked and modified the list of references, where necessary.

Are the references accessible by fellow scientists? Yes.

Is the overall presentation well structured, clear and easy to understand by a wide and general audience? Yes. I still suggest the authors use more subtitles for section 6. For example, they can use subtitles to separate the difference/similarity examination of the two inventories: (1) the number, size and total area (descriptive statistics), (2) the spatial density and (3) the probability density of landslide areas. . . and maybe (4) NDVI, shadow effect and soil slip interpretation. . .

Thank you for the suggestion. We made a try to follow it but the result was an excessive fragmentation of the session since the separation should be done for the original

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inventories and repeated for what we called the "reduced inventories".

Is the length of the paper adequate, too long or too short? The length of the paper is adequate.

Is there any part of the paper (title, abstract, main text, formulae, symbols, figures and their captions, tables, list of references, appendixes) that needs to be clarified, reduced, added, combined, or eliminated? Please go to technique corrections.

Is the technical language precise and understandable by fellow scientists? Yes.

Is the English language of good quality, fluent, simple and easy to read and understand by a wide and diversified audience? Yes.

Is the amount and quality of supplementary material (if any) appropriate? Not applicable.

Technique Corrections:

Page 1022, line 11: "...the shadowed part of the image (Fig. 5) by thresholding the frequency curve (Fig. 6) of the Normalized Difference Vegetation Index (NDVI). . ."- Not quite understand this "thresholding" process. Did the authors set a certain NDVI value to extract shadow areas?

We set NDVI values to extract landslides inside the shadowed areas: "We classified the shadowed part of the image (Fig. 5) by thresholding the frequency curve (Fig. 6) of the Normalized Difference Vegetation Index (NDVI) that exhibits a single peak around zero. We examined a pre-event image available on Google Earth<sup>®</sup>, and found that shadows in the post-event image were in steep and densely forested terrain. We assumed that values of NDVI forming the peak (Fig. 6) were due to lack of vegetation that was stripped from the steep slopes by the new event landslides."

While we identified shadowed areas by working with the Blue channel: "We investigated the reason for the bimodal shape of the frequency of the Blue band (and the other

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bands), and found that the first peak (at Digital Number, DN = 130) was due to pixels located in shadowed areas, and the second peak (DN = 175) corresponded to pixels located in non-shadowed areas. We decided to treat separately the shadowed and the non-shadowed areas, and we split the image accordingly, with the non-shadowed areas covering 68% of the image and the shadowed areas covering the remaining 32% of the area (Fig. 5). To divide the image we used a single threshold selected to coincide with the saddle point in the frequency curve for the Blue band (Fig. 4). “

Page 1103, line 28: 1.8%  
Page 1103, line 11: please explain the “spatial landslide density”.

See previous answer to a similar comment. We have modified the text, that now reads: “We determined the spatial density of the event landslides (number of event landslides per unit area) in the two event inventories using a low pass Gaussian filter moved across the two landslide maps where the landslide presence is initially marked by the value one and landslide absence by the value zero”

Page 1103, line 25:  $E=0.71$ , so please comment this number. The two inventories are significantly different?

$E$  provides a degree of mismatching between the two inventories mainly due to differences in landslide mapping and positioning.  $E = 0.71$  indicates that the two inventories are different; the value is consistent with values found in literature. We have changed language in the Discussion: “The mismatch index  $E = 0.71$  confirms that the difference between the two event inventories is significant, but in the range of the differences measured by other investigators that have compared landslide inventories in similar physiographical settings (e.g., Carrara et al., 1992; Galli et al., 2008; Fiorucci et al., 2011). In addition to the causes for the mismatch discussed by these investigators, in our test case the difference is also the result of the non-perfect co-registration of the satellite imagery, particularly in steep terrain, and of the different resolutions of the satellite and the aerial imagery.”

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Table 1: Please remove “(Fig. 3a)” and “(Fig. 3b)” in the caption.

Done.

Table 2: Please remove “(Stark and Hovius, 2001)”, “(Fig. 7)”, “(Fig. 3a)” and “(Fig. 3b)” in the caption.

Done.

Figure 1: the size of text is too small to read.  
Figure 3: Why not use different color to separate “soil slips” and other landslides.

We moved the legend in the caption, which now reads: “The Pogliaschina catchment. (A) Location map. Dark grey area shows location of the Pogliaschina catchment. (B) Geological map: (1) fluvial deposit, (2) landslide deposit, (3) Monte Gottero Flysch, (4) Clay-rich rocks, (5) Igneous and metamorphic rocks, (6) Macigno Flysch, (7) Scaglia Toscana, (8) Maiolica, (9) normal fault, (10) strike-slip fault, (11) thrust fault, (12) anticline axis, (13) syncline axis. (C) Coverage of satellite and aerial images.”

We accepted the suggestion. Now in figure 3 we use different colours for the different landslide classes.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 1093, 2014.

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