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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Technical Note: An operational landslide early warning system at regional scale based on space–time variable rainfall thresholds" *by* S. Segoni et al.

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We would like to thank the reviewer for the insightful comments. We believe that the quality of the manuscript is improved after the review. Hereafter we reply point-by-point to the issues raised by the reviewer using the following format

reviewer comment

-authors response

"modified text"

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Interactive Discussion

Discussion Paper

The manuscript is written in poor English and should be revised by an English speaking person before submitting it for a detailed revision.

-We have incorporated in the manuscript all suggestions from the two reviewers. A native English speaker will revise the manuscript before the submission of the new version.

Some analyses are not clearly described and thorough. Several statements are too long and lack of clarity, precision, and completeness. For this reason, it is difficult to figure out what the authors have done (see comments below).

-Please consider that the manuscript is a technical note dealing with the setting up of a EWS. We think that the reviewer refers to some parts where the text summarizes the methodology used to define the thresholds. This is part of previous works, which receive the proper credits in the text. We tried to shortly describe the main topics (providing references in case the reader wants to examine in depth the threshold methodology). Unfortunately, in this case shortness leads to unclearness. Therefore, the text has been rephrased, additional explanations were provided and references were added. In particular, we rephrased long statements. Lastly, we expect additional help from the native English speaker that will revise the whole manuscript.

Figures have to be explained with appropriate and detailed captions. Figures 6, 7 and 8 include Italian terms; please translate.

-Figure captions have been revised. The Italian terms are present in the original WebGIS interface, however, for a full comprehension by every reader, the figures will be edited.

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Interactive Comment

I enclose some preliminary comments on the first pages of the paper.

Lines 18-24, page 6600: These sentences are not clear and are written in poor English. In particular: what do you mean for “thresholds that may vary in time adapting at the conditions of the rainfall path”; what are the conditions of the rainfall path? What does it mean “compare with the thresholds all possible starting times”? In my opinion, you can’t compare an intensity-duration threshold to a time. Later you compare the rainfall path to the critical threshold! What is the “critical threshold”? Is it different from the above-mentioned thresholds?

-This sentence was completely rephrased to avoid misunderstandings. “An important feature of the warning system is that the visualization of the thresholds in the WebGIS interface may vary in time depending on when the starting time of the rainfall event is set. The starting time of the rainfall event is considered as a variable by the EWS: every time new rainfall data update the rainfall path, a recursive algorithm identifies the starting time for which the rainfall path is closest to the threshold (or is furthest beyond it). This is considered the most hazardous condition and it is displayed by the WebGIS interface.” In addition, special attention will be paid on this part when a native English speaker will revise the manuscript.

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Lines 25-26, page 6600: What do you mean for “hazard scenario” and “hazard levels”?

-The sentence, leading to misunderstandings, has been rephrased. The new version is:

“The Early Warning System is used to forecast and monitor the landslide hazard in the whole region, providing specific alert levels for 25 distinct alert zones. In addition, the system can be used to. . .”

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Interactive Discussion

Discussion Paper

Lines 10-12, page 6601: This sentence is not clear! Rainfall is the main triggering factor of the landslides you are dealing with. At regional scale, landslide warning systems are mainly based on empirical rainfall thresholds. The use of physically based models requires detailed spatial information difficult to collect precisely over large areas.

- We rephrased the sentence as follows, following the suggestion of the referee:

"At regional scale, warning systems for rainfall induced landslides are mainly based on empirical rainfall thresholds. . ."

———-

Line 17, page 6601: I suggest to change the text as follow "A broad literature exists on empirical rainfall thresholds for the possible initiation of landslides".

-OK

———————-

Lines 21-22, page 6601: What is "the critical rainfall event"? In the abstract, you refer to a "critical threshold".

-The term "critical" has been removed. Here we are dealing simply with the "starting point of the rainfall event".

———————

Line 22, page 6601: What is the "temporal variable"?

-the text was not clear and has been rephrased as follows:

"Therefore, during the monitoring and forecasting activities, the starting point of the rainfall event can be considered as an additional variable. . ."

———————-

Lines 6, page 6602: I suggest to change the text as follow "real-time rainfall measure-

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ments obtained by.."

-OK

———————

Lines 8-12, page 6602: These sentences are very cryptic! English is poor. Please rewrite.

-These sentences have been rewritten as follows

"To account for the high spatial variability of the rainfall-landslide empirical relation, the hazard assessment is differentiated for each of the 25 alert zones. The EWS considers the starting time of the rainfall event as an additional variable and a recursive algorithm identifies the starting time associated with the most hazardous condition." Further details lead to misunderstandings and were removed: we believe that they are not required in this part of the manuscript (introduction). Of course, all details are provided in the "material and methods" section.

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Page 6602: You use both the present and the past tense. You need to be consistent.

-We revised the text.

———————-

Lines 20-21, page 6603: Poor English.

-Special attention will be paid on this part when a native English speaker will revise the text of the manuscript.

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Lines 22, page 6604: I am somewhat concerned since the equations listed in Table 1 do not show an uncertainty associated with the threshold parameters. The analysis of the uncertainty associated with the definition of the thresholds is fundamental especially if

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they are used in operational landslide warning systems.

-The analysis of the uncertainty associated with the threshold parameters has not been performed. Please, consider that this manuscript is a technical note describing how a EWS was set-up and does not deal with the threshold definition, which are part of previous works. However, we revised the discussion section, highlighting this issue as a weak point to be addressed in future research. Furthermore, we provided references showing that the study of uncertainty associated with the threshold parameters is a recent advance in the broad literature concerning rainfall thresholds and giving the proper credit to the first works that introduced this procedure in the DISCUSSION section:

"Another future improvement will regard the quantification of the uncertainty associated to the threshold parameters, which has been introduced for the first time in threshold analyses by Peruccacci et al. (2012) and has not been assessed yet for the threshold used in the EWS. It is important to stress that a constant updating and maintenance activity is scheduled for the warning system. In particular, as soon as new rainfall events produce relevant landslide impacts, the civil protection agency produces electronic records that can be easily joined to the existing landslide geodatabase. As soon as the landslide population increases significantly, the WebGIS interface of the EWS can be used to extract the relative rainfall data and the thresholds can be updated. A constant updating activity is necessary as recent studies demonstrated that an increased landslide sample may lead to an improvement of the performances of the warning system (Lagomarsino et al., 2013) and to a reduction of the uncertainties associated to the threshold parameter estimation (Peruccacci et al., 2012)."

Line 26, page 6603: Please specify the measurement units for I and D.

OK

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Lines 3-5, page 6604: Poor English.

- We rephrased the text as follows:

“A complete insight on the methodology used to define the threshold can be found in Segoni et al. (2014a). Hereafter, we summarize two original features of the threshold analysis performed by Segoni et al. (2014a), as they influenced the setting up of the EWS.”

. . .

“These two peculiar features may be useful to standardize and automate the rainfall analysis, but they need to be consistently replicated in the Early Warning System to ensure a conceptual continuity from the theoretical analysis and the actual operational use of the thresholds.”

In addition, special attention will be paid on this part when a native English speaker will revise the text of the manuscript.

Lines 9-16, page 6604: These sentences are not clear and are written in poor English. I find difficulties to figure out what has been done. Please rewrite

- Please consider that the manuscript is a technical note dealing with the setting up of a EWS. This part of the text summarizes the methodology used to define the thresholds, which is part of a previous research paper. Here we tried to shortly describe the main topics (providing references at P6604-L2 in case the reader wants to examine in depth the threshold methodology). Unfortunately, in this case shortness leads to unclearness. Therefore, the text has been rephrased, additional explanations were provided and additional references to the original article were provided. In particular, we rephrased long statements. Lastly, we expect additional help from the native English speaker that will revise the whole manuscript. The new version of the text, not yet revised by the English speaker, is:

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“Secondly, since the main goal is warning against landslides triggered by extraordinary rainfall events, the thresholds are defined and calibrated setting a relationship between recent landslides and the most severe rainfall conditions measured in their vicinity (Segoni et al., 2014a). The severity of rainfall is estimated with its return period, which can be calculated combining both intensity and duration (Segoni et al., 2014a). The methodology accounts also for the possibility that complex rainfall events may be characterized by a series of peaks of short duration and great intensity (sub-events henceforth) alternated with mild rainfalls or dry periods shorter than NRG. One of these sub-events may be associated to a higher return period: in such cases, its I – D values are used in threshold analysis instead of those of the complex rainfall event.”

———

Line 27, page 6604: I suggest to replace memorized with stored.

OK

———

Line 1, page 6605: The rainfall data are updated at hourly time steps. Especially during severe storms, delays in the data transmission are very frequent. Have you considered this possibility?

- Yes, we are aware of this possibility. However, this part was written poorly and lead to misunderstandings. We have modified two paragraphs of the text as follows.

“Rainfall data are stored in a Comma Separated Value (CSV) file containing, for each rain-gauge, the hourly rainfall intensity measured in mm/h. The file is constantly updated. The FTP server hosts and constantly updates another CSV file containing information such as name, geographical coordinates and elevation of each active rain-gauge belonging to the network. A real-time warning system service is implemented using PHP scripting (http://www.php.net/): every 15 minutes the script sets a connection to the FTP site, checks the presence of updated CSV files, downloads them and

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store the data in a local DBMS (Data Base Management System). According to Shannon theory (Shannon, 1948), the connection frequency should be at least double than the frequency of rain gauge measurements update: this allows in particular a quickly recovery against delays in data transmission and enhances the resilience of the system."

Please note that the old version of the text contained an error: the connection frequency was 30' during the test phase, while at present is set at 15'. We hope the present form could avoid misunderstandings: while the instruments measure rainfall each hour, the systems checks updates every 15'. This redundancy is necessary to improve the resilience of the systems (e.g. if there is a small delay in data transmission, the missing data is recovered and updated after 15' and not after 60').

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Line 6, page 6605: I suggest to change the text as follow "... updated CSV files, downloads them and stores the data in a local DBMS".

OK

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Lines 13-27, page 6605: Poor English.

-Special attention will be paid on this part when a native English speaker will revise the text of the manuscript.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 6599, 2014.