Natural Hazards and Earth System Sciences

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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, which we believe have improved the quality of the manuscript. Hereafter we reply point-by-pointto the issues raised by the reviewer using the following format

reviewer comment

-authors response

"modified text"

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Interactive Discussion

Discussion Paper

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The reviewer rises some general comments, which are addressed hereafter.

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1 additional discussion of the landslide types and processes that are being warned for would be useful to the reader.

- The text was modified as suggested.

In section 2.1:

"Landslide processes have pervasively shaped the Tuscan landscape and still are an active geomorphic process in the whole region. Tuscany is affected by different land-slide typologies, depending on bedrock lithology and landscape morphology. As an instance, shallow landslides prevail in the northern steep mountainsides made up of flysch or schists, while hills made up of terrains or soft rocks are widely interested by reactivations of rotational slides."

In section 2.2:

"Segoni et al. (2014b) demonstrated that the effectiveness of the warning system could be enhanced subdividing the region into 25 independent Alert Zones (AZ) (Figure 1), each characterized by a prevailing landslide typology and by a specific intensity-duration rainfall threshold."

And in section 4:

"After a two years test period, the early warning system is operated by the Tuscany Regional Civil Protection Agency and is used for the hazard related to landslides of all typologies."

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2 With respect to the operational scheme, clarification of the 30-minute latency period

between rain gage observations and ftp transfer of the data to the desktop system should be presented.

-Additional explanations were provided. 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'. Please also note that there is not a latency: 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'). To reflect this content, the text was changed as follows:

"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 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."

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3 The figures are generally fine, although screen shots of computer displays are less than ideal for a scientific article. Legible axes labels should be added to figures 4 and 5. The captions for these figures should also contain an explanation of the various labels. It is awkward to ask the reader to refer to the text to decipher each of the figures.

-Figures were revised.

-We will consider adding the explanation of the labels in the figure captions (see also answer to specific comment to pg. 6606).

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4 The English usage is generally intelligible, but would benefit from an edit with an eye

towards readability.

-The manuscript will be revised by an English native speaker.

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Moreover, we took into account all specific comments.

pg. 6600, line 4: Spell out acronym LAMI

-(Limited Area Model Italy) was added.

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pg. 6600, line 13: Clarify what is meant by "physical features"

-The text was revised as follows:

"To better account for the variability of the geomorphological and meteorological set-tings encountered in Tuscany, the region is subdivided into 25 alert zones, each pro-vided with a specific threshold."

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pg. 6601, line 7: If the locations of landslides could be identified in advance, what is the need for the warning system. Clarifiy

-Some EWS are used for active or dormant well known landslides and are used to monitor/forecast movements or reactivations in time. However, since the sentence was leading to misunderstandings, it was deleted.

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pg. 6604, lines 10 - 15: This paragraph doesn't make sense. Clarify.

-Please consider that the manuscript is a technical note dealing with a EWS implemen-tation. In these lines we summarized the methodology used to define the thresholds, which 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, shortness lead to unclearness. Therefore, the text has been rephrased. Explanations and references were added. Moreover, a native English speaker will take special care in revising this part of the manuscript. The revised text, before the final check by the native speaker, is:

"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 (subevents 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."

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pg. 6606, lines 10 - 20: Move explanation of figure labels to figure captions.

-In this part of the manuscript we do not simply introduce some figure labels, but we introduce some variables that will be used in forthcoming parts of the manuscript. We believe that such references should be present in the text. Maybe they could be organized in a table and the figure caption could refer to that table. We will ask the advice of the Editor before addressing this issue in the manuscript.

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pg. 6607, line 20: Figure showing how forecasts are used in combination with gage measurements would be helpful.

-We believe that the figure is more appropriate in the "Web GIS interface" section:

there, Figure 7 has also the purpose of showing that rainfall cumulates can be fore-casted joining a rain gauge measurements and the LAMI forecasts at its location. To reflect this, the text has been rephrased as follows:

"For each gauge station, local rainfall forecast values are summed to the real time measurements and the cumulative rainfall amount is estimated for four different future scenarios (6, 12, 24 and 48 hours in advance). With the help of a purposely developed WebGIS interface (see next section), it is possible to evaluate a few days in advance whether the threshold will be exceeded or not."

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