Interactive comment on "Which data for quantitative landslide susceptibility mapping at operational scale? Case study of the Pays d'Auge plateau hillslopes (Normandy, France)" by M. Fressard et al.

Response to J.L. Zêzere

The authors wish to thank the careful revisions of the manuscript and the valuable suggestions. Most of the corrections and suggestions were included in the paper to submit for publication in NHESS. The reviewer comments (in italic) are followed by the authors reply (in bold).

Specific comments

1. In the discussion of the State of the Art (Section 1) a reference is missing to physically based methods to assess landslide susceptibility.

A short reference to the physically based models was added in the introduction section.

2. In the end of page 959 the calibration and validation of models are presented as steps that increase the cost of landslide susceptibility. This is not clear and authors should clarify this point.

This point was clarified in the text. (see the introduction section)

3. It is not clear for the reviewer the nature of the superficial deposit numbered (3) in Section 2.1. Authors are asked to be more precise when describing the origin of deposit. In addition, may authors provide any indication concerning thickness of deposits?

We tried to clarify the description of the concerned surficial deposit (see section 2.1). Some general information of the thickness were added, but we have not much information on this point we cannot go more into details.

4. When describing the landslide data (Section 2.2) a reference is missing regarding the number of landslides. Figure 3 is meaningless because authors use 3 different landslide inventories and it is not declared to which landslide inventory the figure applies.

A table summarizing the number of landslides, selected landslides for the modelling and the number of total points used to map the susceptibility was added. The name of the figure 3 was modified, precising the inventory which the figure applies (i.e. inventory n°3)

5. In addition, authors state that solifluction were considered inherited from quaternary and stable. However, figure 3D does not indicate any stability of solifluction. Furthermore, deep seated landslides are considered as naturally stabilized. Authors must be carefull with this consideration; maybe these landslides are is a dormant state of activity.

That is definitely right. This is just clumsiness in the description (since the figure 2 show that only 45% of the deep slides are stabilized). We modified the text in describing that the most part of the observed deep seated landslides are inactive or dormant, and that this type of landslide is rather subject to reactivation than single triggering, which is going out of the topic of the study. For the solifluction, we consider a stabilized or dormant process as well.

6. The modelling strategy is the section that needs further clarifications
6.1 Authors should clearly state the number of landslides they use in each inventory.

This was modified (see the reply to commentary n°4)

6.2. Apparently, the landslide inventory based on field mapping (the most reliable) contains just 27 shallow slides that were used to model landslide susceptibility. Authors should discuss the representativeness of this landslide database and its reliability and consistence to evaluate susceptibility.

A paragraph discussion this issue was added in the discussion section.

6.3. The landslide inventory # 3 used for model contains only shallow slides. The type of landslides in landslide inventory #1 is unknown. Are authors confident they are comparing the same type of landslide?

Definitely not. We used this inventory to illustrate that it is not sufficient to use directly available data for detailed scale analysis. In this case study, only the shallow slides have to be used to map the susceptibility. The solifluction is an inactive or dormant process and deep seated landslides are not characterized by single trigger but by reactivations. Moreover, the BDMvt landslide is affected by serious imprecision that strongly impacts the resulting landslide susceptibility map.

6.4. A figure showing the complete landslides inventories is missing in the manuscript.

A map showing the complete landslides inventories was added.

6.5. Authors use the arcsdm extension to model landslide susceptibility. With this tool the dependent variable should be in point format. None information regarding this is given in the manuscript and this is a major pitfall. How was prepared the three landslide themes to enter into the arsdm tool? How many points per landslide were considered? And what about the location of the point? 6.6. In addition, information is missing regarding the landslide feature used to validate. In fact, what did authors validate (for both calculation and validation)? The total landslide area? The total landslide depletion area? The centroyds of landslide?

A new section relative to the landslide data preparation was added in the text to clarify this point (see section 3.2).

6.7. Authors classify the 5 landslide models by identifying natural thresholds on the cumulative-area posterior probabilities (CAPP) curve. Maybe the use fixed logistic scores to define susceptibility classes will facilitate model comparison.

Since the results are provided by different landslide inventories and different datasets the CAPP curves are characterized by different shapes. The resulting logistic scores are characterized by different extends and it is not possible to define fixed scores to classify the map. It is as well impossible to define the exact same proportion of the study area for each of the susceptibility classes on each map. We nevertheless tried to use roughly equal proportions of the study area to classify the landslide susceptibility maps. Some more details about the classifications problems are provided in the text (see section 3.5.2). We added as well the CAPP curves of each of the models to illustrate the impossibility of defining common criteria of classification. Finally a table summarizing the relative proportion of each class was added to the paper.

7. The section 5.3 is not "in the line" with the rest of the text. The reviewer does not understand the existence of section 5.3. It is not the aim of the manuscript to evaluate advantages and pitfalls of logistic regression to assess landslide susceptibility. I propose to eliminate section 5.3.

The section was removed according to the reviewer suggestion

Technical Corrections

Page 959 Line 1 – "Mulder" instead of "Mudler". Line 2 – "important cost and time consuming measurements" instead of "important measurements".

Corrected

"This method is the most widely used for establishing of official susceptibility and hazard maps in operational contexts." This sentence should be supported by some reference(s).

Corrected

Page 960 Line 13 – "However, there is a demand" instead of "However, there's a demand" Line 14 – "in landslides hazard management" instead of "in landslides hazard managements" Line 24-25 "This area is considered as a test study site that aims to calibrate the methodology and identify the necessary data". This sentence needs to be reviewed and rewritten.

Corrected

Page 964 Line 16-18 "The only landslides referenced by the BRGM in the database with a high degree of certainty and a reasonable spatial accuracy were used for the analysis." This sentence is not clear.

The sentence was simplified.

Line 23-25 "Moreover, the distinction of type and activity of the landslides is difficult and imprecise on the only basis of the photo-interpretation of the ortho-images (quality and resolution of the images, landcover). Not clear the text within brackets.

The text was modified.

Page 967 Line 4 "A grid cell model was used to map the susceptibility as it is the most" instead of "A grid cell model was used to map the susceptibility as they are the most"

Corrected

Page 969 Line 18-19 (Table 3) instead of (Table 2).

Corrected

Page 970 Line 12 "in the sect. 3" instead of "on the sect. 3".

Corrected

Page 972 Line 8-9 "(i.e. the models have difficulties to predict the location of independent landslides)." Instead of "(i.e. the models have difficulties to predict the location of future landslides)".

Corrected

Line 11-14 "Visually, the two maps have very complex zoning characterized by serious artefacts, brutal changes in the susceptibility over very small zones and do not permit identifying a realistic and applicable zoning (Fig. 10)." Sentence not clear.

The sentence was rewritten.

Page 982 Line 13 "Mulder" instead of "Mudler".

Corrected

Figure 1 Scale is missing in sketch A; It is not easy to localize figure A in the map of France.

The scale was added to the figure, and the map of France was enlarged for a better readability.