

## General/Specific comments:

- *the manuscript 'Learning risk management of geohazards in practice with free and open-source web-GIS based platform: RISKGIS' describes and provides an overview of an teaching project with students at bachelor and master level. The web-GIS based platform aims that students learn and understand environmental systems with a focus on geohazards and risk as well as to get familiar with different expert approaches applied in Switzerland. The platform should also allow the lecturer to evaluate the performance of the students and the web-tool. The platform is tested and illustrated by three different examples applied in courses of the University of Lausanne presenting different settings such as bachelor and master level, individual task for students or group work, and high and low number of students. The main results of this study are the evaluation by the students of the different courses using the platform. The idea of the web-GIS platform in teaching and preparing students for their applied work after university has a high potential and is attractive for students by using the approach 'learning by doing'. However, the presentation of this study in the manuscript is a detailed description of the teaching projects, yet it lacks of new scientific insights in the field of education, web-GIS based platforms or risk analysis considering also the existing publication of this project (Aye et al 2016c).*

Thanks for your summary and comment on the potential of the RISKGIS platform. As we already explained to the reviewer 1 (see specific comments), we would like to mention that this paper is not an additional paper of Aye et al., 2016c, and they are not carried out under the same project. Aye et al 2016c was neither designed for students nor for respective courses at the university. Instead, it only served as one of the motivations for the development of this teaching project, since we tested Aye et al 2016c with students for the evaluation of the prototype platform (Aye et al 2016a and Aye et al 2016b) which was meant for experts and decision makers in three European case studies. As we mentioned in Sect. 2, students expressed their interests in performing exercises using such kind of interactive tools. As a result, also considering pedagogical needs, the RISKGIS platform was evolved through the adaptation of our existing works. We will revise this clearly in the manuscript so that the reader would not be confused.

For clarification, new features of RISKGIS are also listed below, compared to the prototype of Aye et al., 2016c. In this study, RISKGIS is specifically designed for:

- certain courses and practical exercises in university for education;
- risk concepts and methods applied in Switzerland;
- rapid risk estimation based on qualitative (vector) hazard intensity map and OpenStreetMap data;
- cost estimation of measures;
- manually edition of new input maps for risk estimation (such as hazard intensity and buildings map);
- cost-benefit calculation of different risk mitigation scenarios and
- additional features such as registration, customized data sharing and interfaces for students and teachers.

Besides, pedagogical scenarios for progressive learning are designed and implemented in this study, starting with the rapid risk calculation and moving on to the more complex risk management concepts incorporating real events of natural disasters as case studies. In addition, test quiz, group assignments and various questionnaires are integrated via the Moodle platform for the purpose of evaluation.

We agree that the presentation of the manuscript should be improved so that contributions and findings of this study are shed to light. Nevertheless, we believe that this study is worth presenting to the scientific and academic community, considering also that it can be reproduced due to its open-source modules and technologies. As the first reviewer questioned, it can be adapted for real decision makers in risk management (Aye et al 2016c is such an example). In the final publication, a link to the source code of the present application can be made available. Even though existing methods are applied in this study, RISKGIS itself can be considered as a new tool beyond the traditional (paper-based or desktop GIS) approach which is currently being used in classroom, and with a bit of web-GIS training, students can benefit from using this platform. Besides, as highlighted in Sect. 1, most web-GIS

tools in education are used for the visualization, dissemination and mapping of spatial data with little capacity for interactive analysis and computing, particularly in this field. Through the presented pedagogical framework applying RISKGIS and OpenStreetMap data, students can not only become familiar with approaches used by experts but also perform a rapid risk calculation of possible different scenarios with available data. Since, in reality, availability of quantitative hazard intensity maps and complete inventory of elements-at-risk are rather limited to carry out a full quantitative risk analysis. Moreover, teachers can also monitor and trace students' performances and progresses in RISKGIS as all data and results produced by students are centralized in the system.

- *For example section 2 highlights some pedagogical concepts and aims, however the questions of the courses evaluation answered by students is not clearly related to these concepts and seems to be strongly based on the standard lecture/exercise evaluation at universities. I miss a clear and structured approach to evaluated a) pedagogical concept/aim of the project and b) the usability of the web-platform. I cannot recommend the current version of the manuscript for publication due to the missing added value for the scientific community as described above. Furthermore, I would recommend re-structuring the manuscript according to focused research questions, considering a clear structure for methods, results and discussion (e.g. questions of the evaluation are part of the methods section) and re-writing a critical discussion section according to the new research questions and highlighting the pro and cons of the web-GIS platform in education. Moreover, I suggest language editing and check used technical terms according the consistency within the manuscript. Some further comments are highlighted in the attached file.*

In section 2, we described pedagogical needs, scenarios for progressive learning, advantages of the web-GIS solution, and pedagogical added values of the project (see also the brief summary of this Innovative Teaching project in page 2-3 of our response to the first reviewer). The aim of the project is to support the implementation of various pedagogical scenarios under the framework of the Environmental Risk and Advanced Quantitative Risk and Vulnerability courses of the university. For this purpose, RISKGIS is developed by adapting the existing work of authors. Some of the paper-based exercises are replaced with RISKGIS, and real case studies of hazard events and approaches used by experts are used in RISKGIS to support the experiential learning of students. This is further complemented by activities such as test quiz, discussion, group work, role-playing and hands-on participation, allowing students to develop skills in problem solving and critical thinking. The findings of this study are then supported by empirical evaluation, based on the observations and feedback collected from students. The usability of the web platform is evaluated by using the SUS method (i.e., a ten-item questionnaire with a simple 5-point scale from Strongly agree to Strongly disagree), as presented in the manuscript.

Regarding the evaluation questions, in the exercise feedback, for example, we asked questions not only about the impact of exercises but also what they have learnt from doing such exercises. Since, most of the times, students only want to finish an exercise without actually trying to understand the concepts behind. Feedback results showed that exercises encouraged students to analyze a problem at hand and reflect on different aspects of the presented topic, for example, in proposing potential protection measures and why these measures should be implemented compared to others. This supported the learning strategies we considered in developing the experiential learning (see Sect. 2). Similarly, the findings of group functioning questionnaires showed that students benefit from each other (despite there were some conflicts) by working together in a group and by playing the roles of stakeholders in risk management. In addition, learning through a web-GIS, students can benefit from learning some aspects of the GIS as there are undergraduate students who never got to learn GIS before using RISKGIS in exercises. This made possible to introduce web-based tools and approaches in classroom and exercises, and students only need to bring their own devices without needing to install additional software for computing.

As we also replied to the first reviewer, probably we did not formulate clearly in Sect. 2 and the following result and discussion sections of three exercises. In Sect 3, we mainly presented background methods developed in RISKGIS rather than evaluation methods for performance of students, exercises and the platform. Instead, evaluation questionnaires were presented separately under respective exercises along with the feedback of students. We plan to

revise respective sections accordingly to highlight pedagogical achievements and main findings in a clear and structured manner, supported by feedback of students and observations in classroom. As suggested, we will also check the language and consistency of technical terms in the revised paper.

**Further comments:**

- *Page 10, line 10: Is this the same reference as EconoMe 2015?*

EconoMe (2015) is the reference to formulas, and OFEV (2016) referred to the actual website of the EconoMe application.

- *Page 11, line 4: see also Fuchs /Mc Alpine.*

Thanks for providing the reference.

- *Page 12, line 12-14: provide this information.*

Later in Sect. 4.1.3 (Results and discussion), we have included this information (quiz and feedback questionnaire) along with feedback results of students. In the revised version, we will provide this information under the relevant section, separating it from the results and discussion.

- *Page 12, line 28: who did this? The students in the exercise or was this prepared by the instructors?*
- *Page 12, line 30: by whom?*
- *Page 16: line 25: by whom?*

The input data were prepared by the instructors including the extraction of buildings from OpenStreetMap.

- *Page 14, line 5-11: this should be part of the methods expect the results.*
- *Page 20, line 2: again the questionnaire is part of the methods not the results.*
- *Page 25, line 2: some remark - parts should got to the method section.*

Thanks for your suggestion. As we mentioned before, we will separate the evaluation questionnaires from the result and discussion sections of exercises.

- *Page 17, line 6: the list does not include questions.*

Thanks for your comment. We will correct it accordingly.

- *Page 18, line 10: this paragraph is a repetition to already described procedure.*

This is because we had a separate sub-section for the stages of the exercise, illustrating how the students performed the exercise in step-by-step using the RISKGIS platform. These stages followed the main procedure we presented in Sect. 3 and Figure 2, except the last Multi-Criteria Analysis component. We will revise it accordingly.

- *Page 19, Figure 8: you use the colour the Swiss hazard map but the information should be the intensity of certain scenario. I think you should use different colours otherwise the student will think that intensity maps is the same than a hazard map (matrix frequency/intensity). You can not derive risk analysis form the Swiss hazard maps.*

Yes, colors represent three intensity classes of a hazard intensity map. Indeed, using the same color styles as the Swiss hazard map can be confusing. We will use different colors in next exercises with students and will also update the figure accordingly in the manuscript.

- *Page 20, line 7: of what?*

We wanted to know if the exercise was useful for students in learning and understanding of the presented topic (contents of the exercise).

- *Page 21, line 5: would this not be an essential aspect for teaching? it seems that the tool is for several parts a black-box.*

We agree that this is essential for students to be able to answer questions such as which measures to select, what are their advantages and disadvantages, and how these measures could reduce the hazard or risk of a given area? The tool provides assistance to students in performing a rapid risk calculation before and after protection measures. However, it does not necessarily model a new hazard map or a new risk situation automatically after protection measures. This is because of the level of complexity involved, and more detailed data and information of the territory are also required, varying according to different hazard types in exercises. Alternatively, other existing tools and simulation models can be jointly applied. Otherwise, additional information and materials are needed to provide during the course and exercises. For example, in this academic year, we provided indicative costs for cost estimations of measures, along with examples of possible measures which can be used for protection against debris flows.