Flood Risk Maps - challenges in risk visualizations

Livia Buerkli, MSc [1]; Claudio Wiesmann 2, MSc; Margreth Keiler, PD Dr [1].

BACKGROUND AND OBJECTIVES

Tools for the identification and presentation of risks gain in importance due to the paradigm shift from hazard defense to a risk based culture (Moel and Aerts, 2011). As one of these tools maps represent an important instrument since natural hazards have a strong spatial component (Martini and Loat 2007). The already existing hazard and intensity maps can serve as a basis for the generation of risk maps. However, official recommendations on standardized procedures for generating risk maps do not yet exist in Switzerland.

The overall objectives of the presented study are to provide an overview of existing risk maps with their contents and to propose suggestions for a purposeful implementation of risk maps for different user groups (Buerkli 2014). If risk is visualized on maps the question arises how realistic the figure of the expected risk is. Therefore, additionally the validity of calculated optional losses for a certain flood scenario is analyzed.

METHODS

For gaining an overview on risk maps an international literature review was conducted using following criteria: risk maps containing the word ‚risk' in the title or legend; and addressing any natural hazard process. In total 39 maps were examined regarding their specific content, target user group and format of visualization. The next step was a risk analysis in the watershed of the Kleine Emme river applied in a GIS-environment using publicly available data (offical cadastral survey & communal zoning plan). In order to make a statement about the validity of calculated potential losses, a comparison with damages recorded by the building insurance of the canton of Lucerne after a massive flood event in 2005 was conducted. For calculating the expected losses only one hazard scenario (without a specified probability of the event), but three different methods to assign value to the elements at risk (e.g. residential, public and industrial buildings) and two different sets of vulnerability factors (average vulnerability factors (BAFU 2012) and to the study area modified factors) were used. In a next step, key findings from the literature review as well as identified important aspects of the validated risk analysis are used for generating risk maps in the case study Kleine Emme. Furthermore, challenges in risk map generation and interpretation are highlighted by addressing needs of different target groups.

RESULTS

Due to the fact that the term ‚risk' can be interpreted heterogeneously, there exist considerable differences between the analyzed maps. Only in risk maps for regions in Switzerland and Austria, the risk is shown as expected loss per time unit [CHF/year].

Maps from Germany partly use a qualitative categorization of risk, while maps from non-European countries mostly involve a risk index.

The results of the validity analysis indicate, that depending on the method used for assigning value to the elements at risk, the damage potential and thus the expected loss varies around factor 3.65. Furthermore, a realistic damage potential (close to the reference value) would not always lead to a realistic expected damage (compared to the recorded damage). Applying vulnerability factors which are deduced from a comparable study area the expected losses are more in line with the observations than with average vulnerability factors.

Since the variety of visualization options of risk maps is quite large, seven risk maps were generated for the watershed of the Kleine Emme river. Figure 1 shows two out of these seven maps. While all the maps are based on the same data, they differ in terms of scale and reference unit of aggregation. Regarding the created risk maps, it is crucial to determine the reference unit of aggregation.

Whether risk is displayed in absolute terms or in relation to a spatial unit (municipality, district or building floor plan) has a considerable influence on the interpretation of the displayed information. Although this is a known challenge of cartography and visualization, a detailed discussion for the visualization of risk maps lacks. While for the planning of protection measurements risk in relation to a spatial unit might be interesting (showing where risk density is highest), land use planners might be more interested in risk in absolute terms (showing the municipality with the highest risk). Furthermore, depending on the target group, additional information like highly vulnerable infrastructure or important cultural or ecological sites should be represented on risk maps.

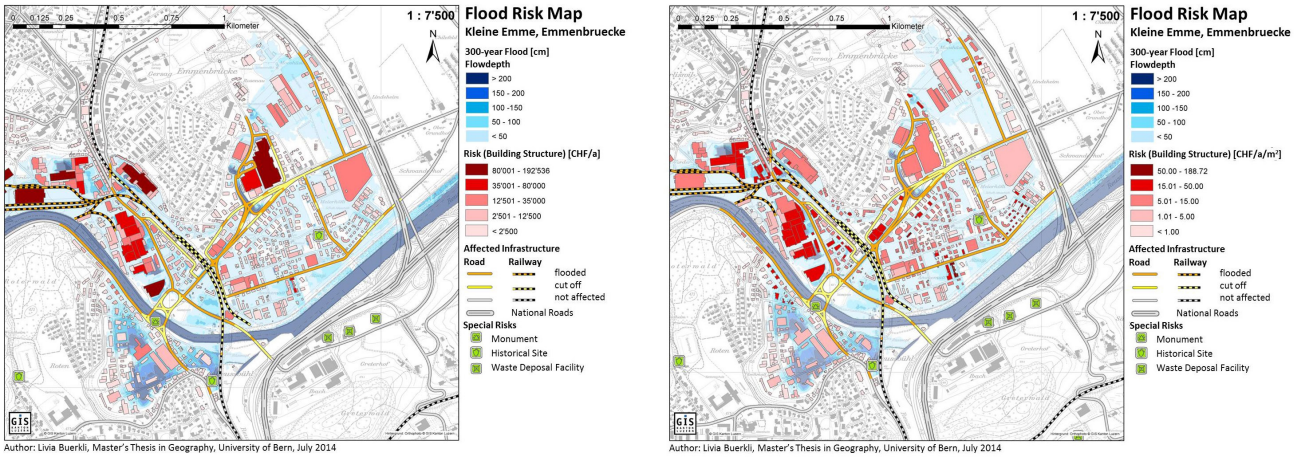

Figure 1. Risk map for the Kleine Emme river in Emmenbruecke (Canton of Lucerne). Left: local scale displaying risk in absolute terms. Right: risk in relation to the building floor plan.

CONCLUSIONS

The created risk maps indicate that it is fundamental to know the purpose of risk maps and to choose the representation of risk appropriately. Depending on the selected aggregation unit different questions can be answered using the risk maps. However, if a non-adequate representation of risk is chosen, risk maps can be easily misinterpreted. Since the calculated damages vary considerably depending on the methods used (how to assign value to the elements at risk and which vulnerability factors are being used), decision making based on the interpretation of risk maps should always consider the uncertainties resulting from the calculation. According to the purpose of the risk maps and the demand on accuracy one should not use average vulnerability factors but invest in the improvement of vulnerability factors or deduce for the study area specified vulnerability values.

REFERENCES

- BAFU (2012). EconoMe 2.2 online tool to assess the cost-effectiveness of protective measures against natural hazards. Documentation (manual). Federal Office for Environment FOEN.
- Bürkli L. (2014). Flood risk maps - overview, validity and appropriate implementation. Master's thesis, University of Bern.
- Martini F., Loat R. (2007). Handbook on good practices for flood mapping in Europe. EXCIMAP.
- Moel H., Aerts J.C.J.H. (2011). Effect of uncertainty in land use, damage models and Inundation depth on flood damage estimates. In Natural Hazards 58 (1), S. 407-425.

KEYWORDS

flood risk maps; risk visualizations; vulnerability factors; validity of calculated optional losses.

1 University of Bern, SWITZERLAND, liviabuerkli4@hotmail.com
2 Canton of Lucerne, risk management team, SWITZERLAND