Methodological approach to assess the exposure of different types of elements at risk on a regional scale

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INTRODUCTION

Losses through natural hazards may imply damage or destruction of the built environment, agricultural areas, injuries or even fatalities. In case of a hazardous event it is likely that various types of elements at risk are affected simultaneously and therefore also various types of e.g. vulnerability assessments for the respective elements at risks need to be applied. In the context of global change it is not only the hazardous process that is changing but also elements at risk, as is demonstrated by new building areas or additional infrastructure as a consequence of socioeconomic factors.
Considering data access as one of the key elements in risk assessment the limitation thereof but also limited resources to generate data for in depth analysis of natural hazard risk and vulnerabilities of different types of elements at risk is often an obstacle. Additionally limited time resources can necessitate a broad analysis before going into depth in certain locations. Therefore an initial exposure assessment on regional scale addressing various types of elements at risk can be beneficial to identify hotspots which might require further analysis in the future.

METHOD

The proposed method is based on a raster calculation enabling the inclusion of various types of elements at risk according to availability and scope of analysis. Referring to the exposure of a certain natural hazard, a map of the spatial extent of the susceptibility or hazard respectively is necessary. For regional scale risk analysis susceptibility maps are often used as input for the natural process instead of hazard maps. Therefore it is necessary to adjust/ enlarge the single features of elements at risk to ensure that the potential extent (e.g. runout area) and the related uncertainty of the hazardous process are considered. Subsequently a buffer that is delineated from empirical data on the respective hazard is adducted before converting these into raster datasets.
The proposed exposure analysis is based on a superimposition of different types of elements at risk e.g. roads/streets, critical infrastructure or residential buildings and a susceptibility or hazard map to identify locations where certain elements at risk coincide with highly endangered areas on a regional scale. This raster based approach addresses various types of elements at risk. The spatially explicit binary (element at risk present 1 / not present 0) maps of the different types of elements at risk are superimposed in a first step to determine how many layers are affected in one location (indication on damage potential) before these are overlaid by the susceptibility map (Figure 1). The resulting code allows tracing back which elements at risk are affected by the different levels of susceptibility.
The method was tested by Promper et al. (2014) for landslide exposure for the district Waidhofen/ Ybbs, Lower Austria. The landslide susceptibility map was prepared using logistic regression and was grouped into 4 classes (low to very high). Before rasterizing the layers of elements at risk a buffer was applied to the features. This was based on the average length of the landslides in the area to account for all parts of the landslide and limit underestimation related to exposure. The results of the superimposition with the multiple layers of elements at risk indicate that it is possible to delineate hotspots where e.g. street/road and building area plus critical infrastructure are affected by high landslide susceptibility in certain locations and therefore require further analysis. Additionally it allows for weighting of the maps by designating different values for the binary map e.g. 2 instead of 1.

CONCLUSION

Related to aspects of global change the method allows to easily exchange or add datasets which allow a straightforward transfer of the method in space and time. Additionally it allows incorporating different hazard maps e.g. a combination of flood and landslide prone areas. This is indeed based on a minimum amount of data related to the desired hazardous process and elements at risk and subsequently also multiple sources of uncertainty. However the method enables a resource efficient assessment of exposure to natural hazards on regional level and the detection of hotspots for in depth analysis.

REFERENCES

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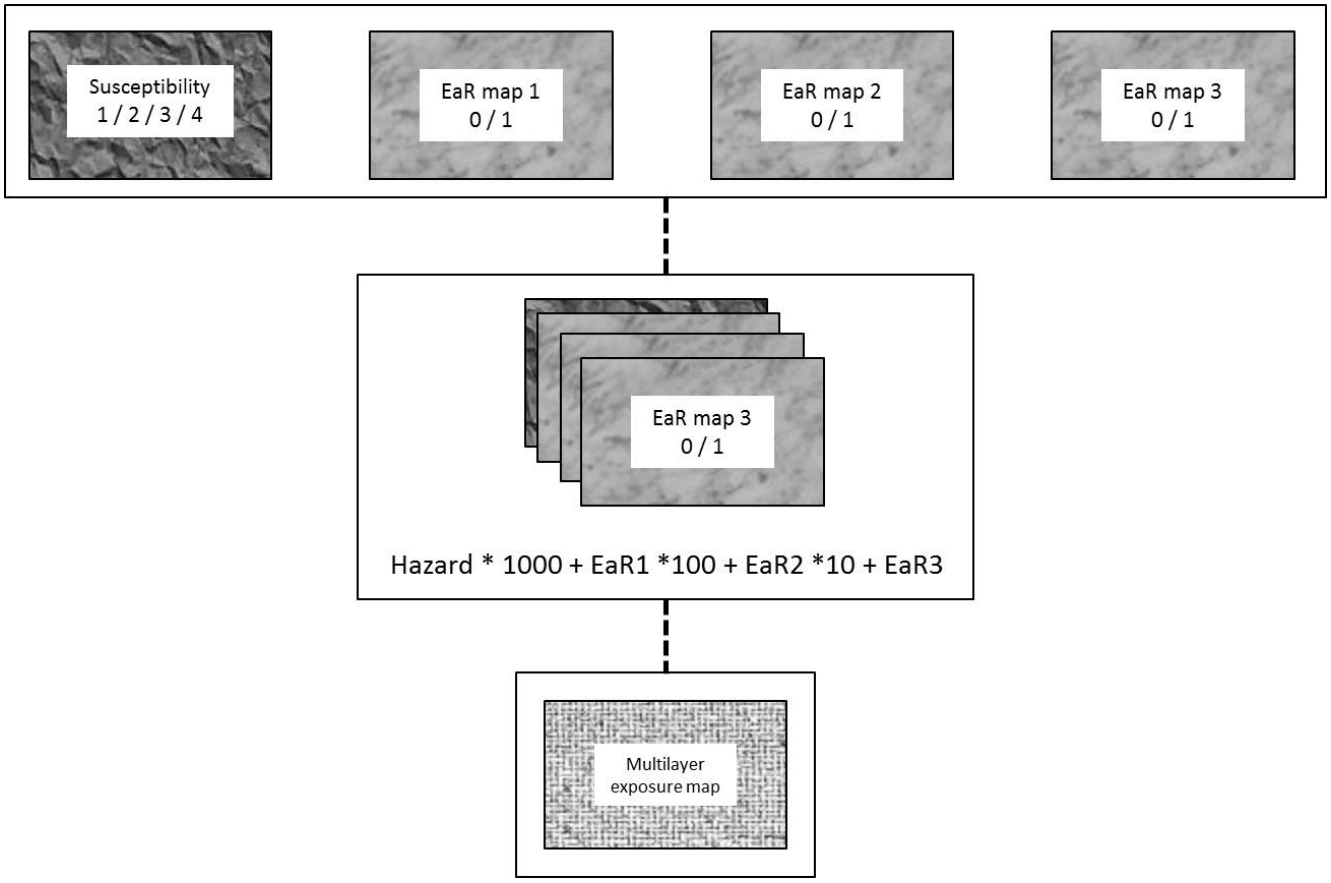

Figure 1. Methodological approach to calculate a multilayer exposure map (Promper & Glade, 2016)

KEYWORDS

exposure; risk assessment; natural hazards; elements at risk; damage potential

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