Exposure to floods in Switzerland

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INTRODUCTION

Hazard mapping, exposure and vulnerability analysis - these are the main components of a risk assessment. For floods, the Swiss cantons elaborated hazard maps according to the national guidelines (BWW et al. 1997). Hazard is thereby described by a combination of its intensity and its probability of occurrence leading to the spatial representation of five hazard class: „high“ (red coloured areas), „medium“ (blue), „low“ (yellow), „residual“ (yellow-white striped) and „no or negligible“ (white) threat. While the flood hazard mapping in Switzerland is largely completed, only few and selective studies on exposure and vulnerability were conducted to date. Several cantons investigated exposure and/or vulnerability to floods and many insurance companies use the hazard maps for their portfolio risk management. However, these studies are either limited in space (e.g. to the area of a canton) or in content (e.g. the assets insured by a single company) and are rarely published.

The presented research project aims to fill the gap of a national-wide analysis of exposure to floods in Switzerland. It focuses on the exposure of buildings.

METHODS

The flood hazard maps - as available at the end of 2014 - are harmonized and compiled in a geodatabase by Mobiliar insurance company. The flood hazard maps are overlapped in a GIS with two different sources of spatial referenced data on buildings.

One source comprises the harmonised building zones all over Switzerland and is available at the federal administration (ARE 2012). It shows the spatial extension of building zones as per January 2012, classified into nine categories according to their main purpose. By intersecting the flood hazard maps with the harmonised building zones, the proportion of area of different building zones to the five hazard class („high“; „medium“; „low“; „residual“; „no or negligible“) is determined.

The other source is the federal register of residential buildings and dwellings (in German: Gebäude- und Wohnungsstatistik (GWS)) which includes for every residential building the coordinates (centroid) and many features as building category (detached family house, apartment building…), year of construction or number of rooms (BFS 2012). It is available for scientific purpose and captures the state at the end of a year. For this study, the state at the end of 2012 is used. As with the harmonised building zones, the intersection of the GWR centroids with the hazard maps leads to the allocation of residential buildings and dwellings to the five hazard classes.

RESULTS

For 1‘343km^2 of building zones a flood hazard map exists, this corresponds to 58% of the total area of building zones (2‘284 km^2). 363 km^2 (27%) of the mapped building zones are at flood risk, thereby the hazard class „low“ (yellow) has the largest extension (157km^2, corresponding to almost 12% of the mapped building zones). The proportion of building zones at flood risk varies for the different categories of main purpose. While the residential zones have the lowest share (19%), working zones and tourism zones are most exposed with a rate of 40% and 44%, respectively.

Tab. 1 summarizes the results of the intersection with the centroids of residential buildings. Almost 1 Mio of centroids lie within a mapped area and 19.64% of them are at flood risk. Fig. 1 shows the percentage of centroids at risk (compared to all centroids with a flood hazard investigation) for each year of construction and for the different hazard classes. It demonstrates that the exposure of new buildings varies between the periods of construction, with a percentage over all hazard classes between 16% (period 1981-1985) and 23% (buildings constructed before 1919). The greatest relative differences between building periods are

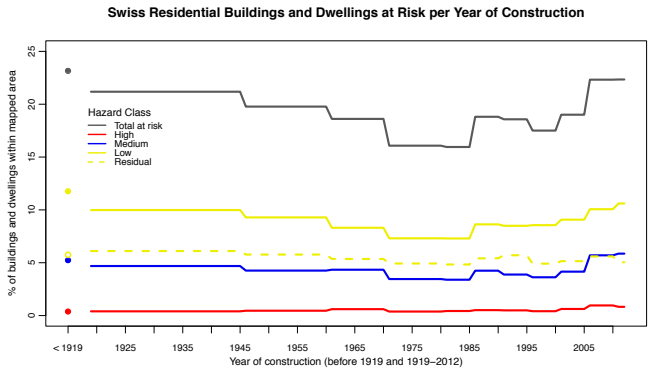

Figure 1. Exposure per year of construction

within the hazard class „high“ (red). While among the buildings constructed before 1919 and in the period of 1971-1980 only 0.38% is assigned to this class, this proportion accounts of 0.96% in the period 2006-2010.

DISCUSSION AND CONCLUSION

Concerning overall exposure to flood, both intersections show comparable results with 20% to 27% of elements at risk. This proportion is furthermore in line with existing cantonal exposure analyses. Remarkable are the results for the different periods of construction of residential buildings: Under the assumption that since 1919 no building has been demolished and the extension of flood areas has not changed, the figures in Tab. 1 demonstrates that the relative increase of buildings within flood areas (452%) was lower than in areas with no or negligible threat (557%). However, the greatest relative increase is reported for the hazard class „high“ (674%). Moreover, Fig. 1 indicates the temporal evolvement of flood exposure. Outstanding is the dichotomy of the two periods before and after 1985, respectively. While the first period shows a constant decrease of percentage of buildings constructed in flood areas, the second demonstrates an increase in particular for the period 2005-2012. Sound interpretations of these results, especially considering the influence of the taken assumption are crucial. Analyses of further spatial datasets on buildings will improve the robustness of these first insights.

REFERENCES

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Table 1: Exposure of residential buildings and dwellings to floods in Switzerland

Intersection of GWS 2012 database with flood hazard maps 2014

	< 1919[1]	All years of construction		
	[N]	[N]	% of < 1919[2]	% of mapped[3]
Total buildings in database GWS	336'167	1'670'054	497	168.97
Total buildings in mapped areas	185'520	988'346	533	100.00
Buildings in hazard class "high"	711	4'792	674	0.48
Buildings in hazard class "medium"	9'728	43'379	446	4.39
Buildings in hazard class "low"	21'835	91'886	421	9.30
Buildings in hazard class "residual"	10'673	54'095	507	5.47
All buildings at risk[4]	42'947	194'152	452	19.64
Buildings with "no or negligible" threat	142'573	794'194	557	80.36

[1] Buildings with year of construction before 1919
[2] Proportion of buildings with all years of construction to buildings with year of construction before 1919 (in percent)
[3] Percentage of all buildings in mapped areas
[4] Sum of buildings in hazard classes "high", "medium", "low" and "residual"

KEYWORDS

floods; Exposure; spatial analysis; temporal analysis; Switzerland

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