



Hydro-geomorphologic disasters in Portugal: mortality trends in the past 150 years

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For the first time in Portugal, an extensive analysis of the mortality caused by hydro-geomorphological hazards was made, for a long period (1865-2010) using the DISASTER database (Zêzere et al., 2014). This database was built under the assumption that social consequences (including fatalities) of floods and landslides are relevant enough to be reported by newspapers, which were the source for data collection. This database counts 1902 hydro-geomorphologic cases that caused 1248 fatalities, 14 191 evacuated persons and 41 844 homeless persons. Floods correspond to the majority of cases (85.2%) that caused 1012 fatalities. Landslides correspond to 14.8 % of the total hydro-geomorphologic cases and caused 236 fatalities.

The exploitation of the DISASTER database allowed: (i) to analyze the frequency and the temporal evolution of fatal floods and landslides; (ii) to analyze the spatio-temporal distribution of fatalities; (iii) to identify the most deadly flood and landslide types; and (iv) to evaluate the individual and societal risk.

The obtained results demonstrate the absence of any exponential growth with time of hydro-geomorphologic cases and associated fatalities in Portugal. The highest flood and landslide cases as well as the associated mortality were registered in the period 1935-1969. After this period, flood and landslide mortality decreased, although landslide fatalities remained higher than the registered in the period 1865-1934. These features do not account the exceptional flash flood event occurred in the Lisbon region in November 1967. This outlier event was responsible for 522 fatalities, which corresponds to more than half of the total mortality generated by floods in Portugal in the complete time series (1865 – 2010). Moreover, the 1967 flash flood event was the deadliest natural disaster registered in Portugal after the Lisbon earthquake occurred in 1755, not accounting heat waves.

Flood fatalities occurred widespread in the country, with an important cluster in the Lisbon Region and in the Tagus valley, Oporto and Coimbra cities, where simultaneously, natural conditions are favorable to floods and a high number of people are exposed to flood hazard (e.g. residential buildings and economic activities installed in floodplains). The occurrence of landslide fatalities is mostly constrained in the north of the Tagus valley, where geologic and geomorphologic conditions are more landslide-prone than in the southern part of the country.

Flash floods caused the majority of fatalities associated with floods, while falls and flows were responsible for the highest frequency of fatalities associated with landslides.

The temporal evolution of flood fatalities reflects the implementation of territorial management policies and the improving of early warning systems for floods and the evacuation of people living in floodplain areas prior major flood events, in Portugal in the latest four decades. In the case of landslides, despite the improving in the quality of buildings construction, fatalities generated by landslides are still frequent because buildings are often located in hazardous slopes. In addition, so far no early warning system for landslide was implemented in Portugal.

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