Time dependent scenario of powerful multirisk events on the Bulgarian Black Sea coast

Времеви сценарий за комплексния риск от опасни явления по северното Българско Черноморско крайбрежие

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Абстракт. Моделирано е развитието на времеви сценарий при реализация на силно моделно земетресение и развитието на последващи опасни вторични явления (сеизмични, свлачищни и цунами). Показано е, че времето на въздействие на отделните опасни въздействия е различно, дори при едновременното им случване. Направен е преглед на досегашни случаи и е показано, че подобен сценарий ще е по-скоро правило, отколкото изключение. Оценено е времето на продължителност на опасните въздействия и възможните уязвими елементи от тях. Съставена е количествена таблица за динамиката на опасните явления, техните основни параметри, очакваните ефекти върху различни уязвими елементи — туристическа инфраструктура, населени места, население и др.

Keywords: multirisk scenario, strong earthquake, landslides, tsunami, Black Sea

Introduction

Several international projects include as a test site the North Bulgarian Black Sea coast (i.e. TRANSFER, SCHEMA, Risk mapping, etc.) The interest is created, because this area (from Varna to the South to the national boundary to the North) can produce so called "multirisk" or ("complex risk" — i.e. risks related to several natural (or man-made) hazards). The main disasters in the investigated area could be expected as strong earthquakes, generated landslides and tsunamis, especially if the strong seismic events realize is in the aquatory of the sea. If so, these strong earthquakes (usually with an expected magnitude around or above 7.0) could generate as secondary effects large landslides and/or tsunamis. In such case the negative consequences could be: destructions created by the strong shaking of the earthquakes, large mass movements due to the landslides, which can generate destructions and infrastructure disturbances and floods (inundation) due to the tsunamis. The main generators of the tsunamis usually are the powerful seismic events. In case of such events in unstable lands, the additional effects to the tsunami generation process could be produced by surface ground mass movements (landslides, rock falls, and large subsidence) and/or the submarine mass movements (turbidities, gas hydrates degradation and/or mud volcanoes eruptions). The time dependent development of the simultaneous action of such events is under investigation in this paper.

Earthquakes

The area is famous with its seismic regime. The region usually shows non regular behavior of the strong events occurrence. There are episodes of activation and between them long periods of seismic quiescence. There are several famous strong events during the historical times. The most important one is at the Ist century BC when according to Strabon, the ancient Greek colony Bisone sank in the waters of the sea. Today this city is called Kavarna and was moved at the ancient times to the near plateau, because of this episode. The seismic source is known as Shabla-Kaliakra zone with the best documented seismic event of March 31, 1901. This event had a magnitude of 7.2 (estimated by the macroseismic transformation formula) with a source depth of about 10-20 km. The epicenter was located in the aquatory of the sea. The observed macroseismic intensity on the land had the maximum value of X degree MSK. This event produced a number of secondary effects (Григорова, Григоров, 1961) — landslides, rock-

Table 1. Multihazard activity

Time [s]	10^0	10^2	10^3	10^4	10^5	10^6
Events:						
Earthquake						
Landslides:						
a. submarine						
b. onshore						
Tsunamis						

falls, subsidence, extensive destruction of the houses located around and tsunami (up to 3 meters height observed at Balchik port (Рангелов, 1998). This event is selected as referent one and the scenario is related with all possible consequences, mainly focused on the effects of slides (surface and submarine) and expected tsunamis. Aftershocks are also the phenomena, which accompanied the earthquake. For this zone the expected aftershocks could be expected with power less then magnitude 6.0. This could be expected as intensity less then VIII.

Landslides

The area on the north Bulgarian Black Sea coast is covered by many active landslides. They have different size, depth and activation time. Most of them are located near the coastline thus presenting huge danger about the beaches, tourist infrastructure, population and historical heritage (Рангелов, 1998). The most famous landslide (subsidence) is related with the Ist century BC seismic event, when a huge mass slides in the waters, buried Bisone and created the peak Chirakman. The event of 1901 also created landslides, subsidence of a huge land block with dimensions of about 1x1 km and rock falls with large boulders. The landslide could be also submarine; creating is such was turbidities and/or mudflows from the bottom deposits like sapropel breccia and mud volcano depositions.

Tsunamis

Such earthquakes (magnitude greater then 7.0) almost always trigger tsunamis. They could be generated by the earthquake rupture process, or more frequently by the secondary triggered phenomena — landslides (submarine or surface) and/or other geodynamic phenomena — rock falls, degradation of gas hydrates, etc. the most famous water level change is described by Strabon — related to the great catastrophe. The paleotsunami deposits from this tsunami have been discovered to the south (Рангелов, 1999). The better observed by witnesses tsunami is related to the 1901 seismic event. The area shows also some other expressions about tsunamis — the last one — a non seismic event at May 7, 2007 with maximum observed amplitudes of about 3 m water level changed amplitude.

The time dependent scenario

The initial data about the time development of the hazards phenomena is based on their main physical properties — size, location, velocity of the process, intensity (magnitude), etc. The table about the main parameters, possible consequences and general threaten objects is created. The main time development of the disasters in case of the referent event (magnitude 7.2) is presented at the time chart diagram.

The time chart development of the selected hazardous processes is presented in Table 1.

The surface landslides and aftershocks (dashed line) time durations are going out the time chart limits. It is clear from the time chart that there is a time interval when all phenomena (or some combination of them) act simultaneously (the time of the multihazard activity), creating multirisk effects.

Conclusions

The time dependent scenario in case of a referent M7.2 seismic event is under development. The investigations about the consecutive and simultaneous action of all selected hazards and their multirisk effects are performed. The results obtained show the complex possible consequences and interrelated dependences.

References

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