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Estimating tsunami hazards between Lefkada and Preveza, NW Greece, by means of computer modeling

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Abstract

The intention of this paper is to outline selected results of modeling hypothetic tsunami events for the present coastlines between Lefkada Island and the southernmost areas of Epiros, NW Greece. Modeling results are compared to geoscienctific field evidence of palaeotsunami landfall which have been found during the last years. Moreover, possible consequences of modeled extreme wave events on the shores of the Lefkada-Preveza coastal zone are discussed.

1 Introduction: Tsunami in the study area

Within the study area, several hints for former tsunami impacts were identified during previous studies (Vött et al. 2007, 2008, 2009a, May et al. 2007). Widespread wash-over fans strike at the spit between Lefkada Island and Akarnania. Numerous large blocks of up to 14 tons in weight, made up of beachrock, were obviously mobilized and dislocated, partly appearing in an imbricated assembly. In the nearby Lake Voulkaria, a layer of marine high-energy deposits was identified, sandwiched between units of limnic mud (Vött et al. 2009b). Furthermore, an evaluation of several tsunami catalogues revealed the occurrence of at least 46 tsunamis in the eastern Ionian Sea within the last 2400 years, eight of which were also observed around the study area (Soloviev et al. 2000, Vött et al. 2006).

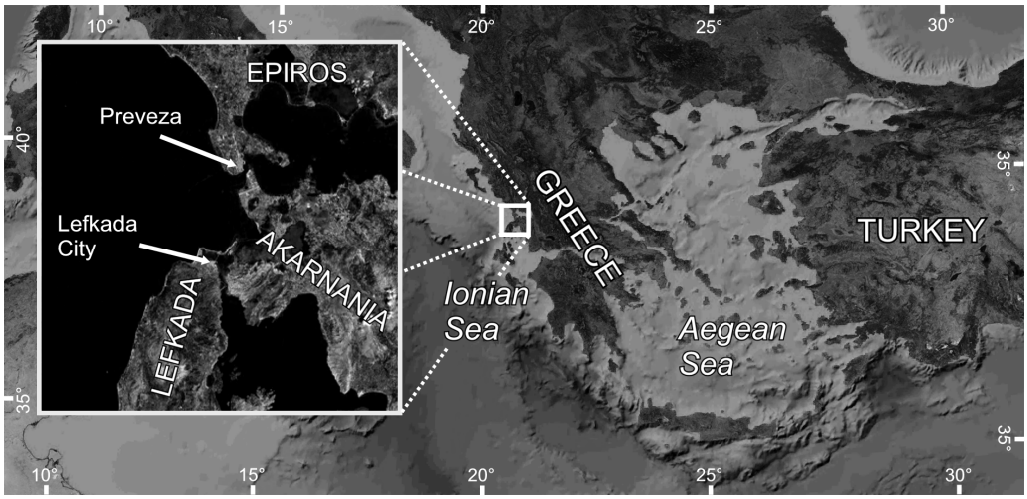

Figure 1: Situation of the study area showing the location of the towns of Lefkada City and Preveza (Source: NASA WorldWind 1.4, Landsat 7 ETM Satellite Image, modified)

2 The Model

AnuGA was developed by the Australian National University and Geoscience Australia in consequence of the tsunami-event of late December 2004 (Nielsen 2007). The focus for the simulation of tsunami affecting the coasts of the study area was on generating a sinusoidal wave train on the western boundary. The idea was to compute 15 scenarios on the base of three distinct directions of origin (WNW, W, WSW) and with five qualitative degrees of intensity, the latter corresponding to the maximum generation height of the waves at the western boundary of the studied area (2 m = slight, 5 m = moderate, 10 m = severe, 20 m = strong, 50 m = extreme; Floth 2008, Floth et al. 2009).

3 Potentially endangered objects

Within the study area, two major towns can be identified: Lefkada City, lying at the northwestern end of the Sound of Lefkada with a population of approx. 11.000 people, and Preveza, located at the entrance to the Ambrakian Gulf with approx. 20.000 inhabitants. Further villages are situated around the Sound of Lefkada, predominantly on the westernmost part of Akarnania, called Plaghia Peninsula. Those show a number of up to 1000 residents. The village Aghios Nikolaos, situated on the coast right between the cities of Lefkada and Preveza shows a population of approx. 500 people. Other objects of importance are the civil-/Nato-airport of Actio Headland with some 3000 flights per year just as the undersea tunnel connecting the Preveza Peninsula with Actio Headland (Floth 2008).

4 Case study Preveza

Like all other parts of the study area, the region of Preveza seems to be well protected from minor tsunami-events (figure 2). This is mostly due to the fact that the town is built on the shore of the inner Ambrakian Gulf and thus averted from the open sea. Our data show that only a severe or stronger event would cause damages or even fatalities in edge areas. Surprisingly, tsunamis from WSW do not show the strongest effects, although hitting the coast with an almost perpendicular direction. However, they trigger highest inundation values for the harbour area. Especially the north of Preveza seems to remain untouched by tsunami wave action, while the simulations show strongest impact to the SE quarters along the coast. (Floth et al. 2009).

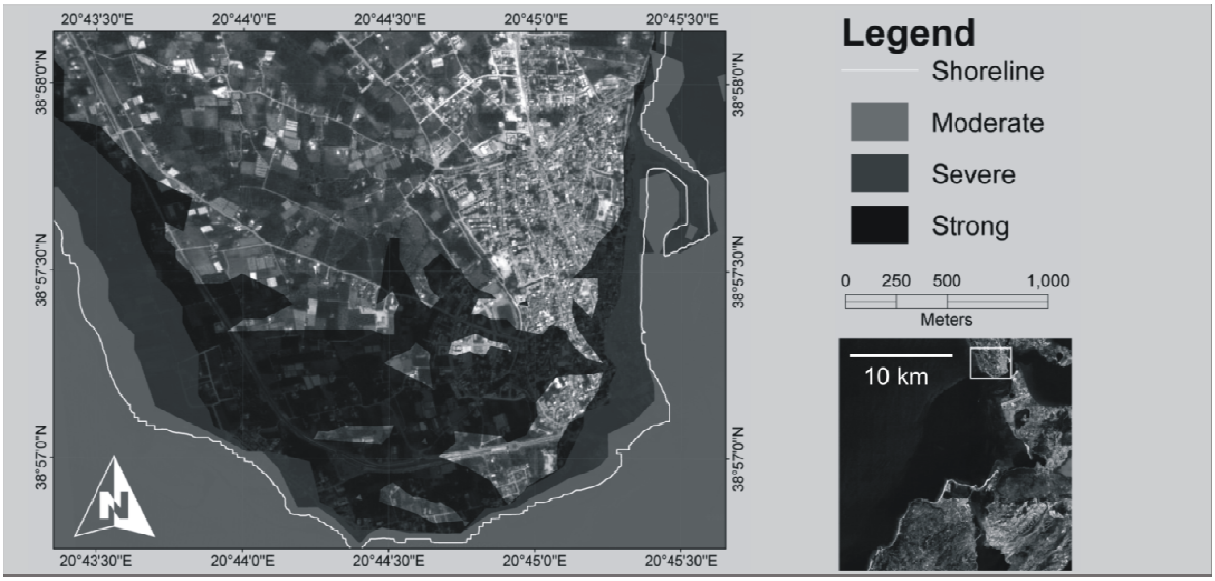

Figure 2: Potentially flooded areas of Preveza in case of tsunami from WNW (Image based on Ikonos and Landsat 7 ETM Satellite Images) for tsunami categories “moderate”, “severe” and “strong”.

Sedimentary evidence of tsunamigenic flooding was found for the entire coastal zone between the cities of Lefkada and Preveza, locally testifying to multiple tsunami landfall during the Holocene (May et al. 2007, Vött et al. 2009a). Geomorphological and geoarchaeological traces document the more or less complete inundation of Actio Headland directly opposite to city of Preveza (Vött et al. 2007). These results also imply tsunami-borne damages to modern Preveza and distal areas of the nearby Louros River delta. Geo-scientific studies to the immediate NNE of the city revealed at least one major tsunami impact during the past millennia. Compared to geo-scientific field data, our modeling results strongly corroborate the tsunami hazard for the Preveza-Lefkada coastal zone concerning both flow direction and spatial dimensions of extreme wave events (Floth et al. 2009).

5 Conclusion

Our modeling results clearly show that all locations in the study area are well secure from minor tsunami-events. This is explained by their sheltered position behind spits and beach ridges (Aghios Nikolaos, Lefkada City) or on the lee-side of a peninsula (Preveza) and by their sheer elevation (Plaghia villages) or distance from the sea (Airport facilities).

In case of major events, however, almost all inhabitated sites are endangered of peripheral to an entire flooding.

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