Abstract

The western Corinth Gulf, central Greece, is characterized by steep slopes and large sediment river discharge, that are factors increasing the occurrence probability of underwater landslides. Thus the generation of tsunamis from submarine movements is expected to be frequent in this region, and this is confirmed in the historical tsunami catalogues, where reports of tsunamis related to landslides exist either triggered by earthquakes or by gravitational load. In this work we concentrate on the numerical simulation of submarine landslides and of the propagation of the ensuing tsunamis. We elaborate different scenarios basing on recent swath-bathymetry and seismic profiling surveys performed by the Hellenic Centre for Marine Research (HCMR). The most prominent potentially unstable bodies are found in three different regions: one is placed in the area off the city of Aigion, the second is located close to the Psathopyrgos fault, and the third occupies an elongated area off Eratini on the northern side of the gulf. All considered landslides are characterized by relatively small volumes (in the order ranging from $10^5$-$10^7$ m$^3$). For each scenario, the slide motion is simulated by means of a Lagrangian block model, implemented in the numerical code UBO-BLOCK1, developed by the Tsunami Research Team (TRT) of the University of Bologna, Italy. The tsunami generation and propagation modelling is carried out through the finite-element code UBO-TSUF E, developed by the same research team, solving the Navier-Stokes equation in the shallow water approximation on a triangular-element mesh. We will show how landslide-induced sunamis propagate inside the western Corinth Gulf, the amplitude and period of the tsunami waves at some selected coastal points, and the spatial distribution of the extreme wave heights along the coast.

1. Introduction

The western Corinth Gulf, central Greece, is a well-known geologic structure: it is an active rift zone with a substantial N-S opening rate of about 1.5 cm/yr (De Martini et al., 2004; Cornet et al., 2004), that reflects into a well documented strong seismic activity (Papadopoulos, 2000). As a consequence, it is not surprising that the coasts of this basin have been affected in the past by a large number of destructive tsunamis of seismic origin (Papadopoulos, 2003). In addition, the morphology of the basin flanks is dominated by steep slopes, where large amounts of sediments are discharged by large rivers, creating favourable conditions for sediment failure under seismic or gravitational load (Lykousis et al., 2003). In fact, landslide tsunamis are here relatively more frequent than elsewhere in the Mediterranean. An important example is the 1963 tsunami that was generated by a submarine sediment slide, triggered by a small earthquake: the wave reached the maximum run-up height of about 6 m near the city of Aigion, with maximum horizontal inundation of 120 m (Papathoma and Dominey-Howes, 2003).
Other significant cases are the tsunamigenic sediment failures in the Tolofonas delta, near Eratini in the northern coast, and in the Eliki delta in the southern coast of the gulf that were both the consequence of the 1995 Ms=6.1 Aigion earthquake (Papatheodorou and Ferentinos, 1997; Hasiotis et al., 2002). Therefore, in the western Gulf of Corinth, besides the hazard from seismic shocks, one has to count also the hazard due to tsunamis produced by co-seismic sea-floor displacement or to tsunamis generated by landslides deriving from earthquakes or simply from gravitational overload (Armigliato et al., 2006; Stefatos et al., 2006). In view of risk assessment and mitigation, studying tsunami generation and impact is crucial in this area where a high population density is concentrated within a narrow coastal belt especially in the peak tourist season.

This work, performed in the framework of the European project 3HAZ-Corinth, develops scenarios of tsunamis produced by underwater landslides in the western Gulf of Corinth. The sliding bodies are located in three different regions (Figure 1). The first one is in the Aigion area, where a number of slumps triggered by earthquakes associated with the Aigion fault (Koukouvelas, 1998; Pantosti et al., 2004) have been reported to occur (Papadopoulos, 2003). The second is located near the Psathopyrgos fault, in the western part of the Gulf, and includes also the Mornos river delta. Last, the third one is located in the Tolofonas-Eratini coast, again associated with a river mouth, where sedimentation rate and sediment accumulation are quite significant. In our approach, the simulation of the motion of the sliding bodies provides the input for the tsunami simulation code.

2. Numerical models

The numerical elaboration of the tsunami scenarios taken into account here implies a two-step model: first, modelling the landslide motion, and then modelling the ensuing