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# PREPARATION OF INUNDATION MAPS DATABASE FOR TURKISH NATIONAL TSUNAMI WATCH CENTER

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Historical documents, seismic activities and numerical modeling studies are clear evidences that tsunami hazard should be extensively investigated and tsunami preparedness strategies should be attentively planned in Turkey. In this respect, Kandilli Observatory and Earthquake Research Institute (KOERI), as an experienced institute in earth science and observation since 1868, joins and contributes to the initiative of a Tsunami Warning System in the North-eastern Atlantic, the Mediterranean and connected seas region (ICG/NEAMTWS) under the framework of UNESCO-IOC (Intergovernmental Oceanographic Commission) in 2007. As a result of devoted studies within the collaboration of several national and international agencies, KOERI leads to the Turkish National Tsunami Watch Center (NTWC) acting as a Candidate Tsunami Watch Provider since July 1, 2012 in the framework of ICG/NEAMTWS.

Turkish NTWC is responsible for monitoring the earthquakes within a specified observation area, detecting the earthquakes with Mw≥5.5, analyzing their tsunami potential by using a tsunami scenario database, disseminating the tsunami alert messages which includes the names of the alerted countries and the list of Tsunami Forecast Points (TFPs) with the arrival time of first wave, and monitoring the water surface elevations at the sea level stations in order to confirm or cancel the tsunami alert in the region.

As well as the determination and dissemination of the tsunami arrival time at the TFPs, it is essential to analyze the tsunami inundation along the coastal settlements comprehensively in order to mitigate the tsunami damage and casualties to a great extent. For this reason, the study domains covering the TFPs along the Turkish coasts are determined and very fine bathy-topo maps are obtained including the coastline, the buildings and sea structures such as breakwaters, groins, piers, berthing places, etc. that are all digitized from the satellite images (see Figure 1).

This study describes the procedures of tsunami modeling studies performed by using these fine gridded maps in order to determine the tsunami hydrodynamic parameters as water surface elevation, current velocity, flow depth and the square of Froude number which is derived as a relevant parameter with the tsunami damage along the coastal settlements (Ozer, 2012) and the preparation of inundation maps covering Dalaman region and Gocek, which is a very popular touristic destination especially for the yachtsmen. Strong geological evidences exist that support tsunami events happened in this region through history (Papadopoulos et al, 2012).

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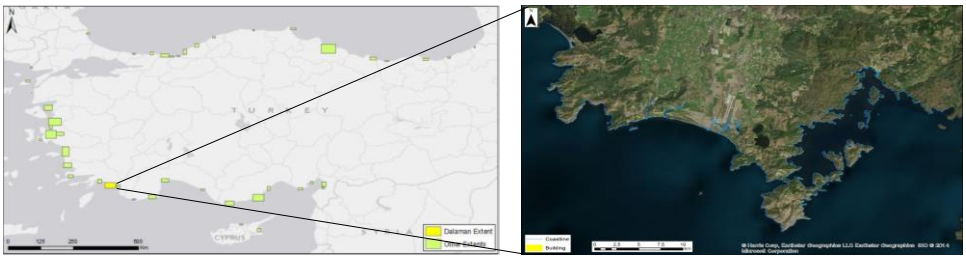

Figure 1. The locations of TFPs and the digitized coastline of Dalaman region at the Southwestern coast of Turkey

The numerical model NAMI DANCE is used in the analyses which is developed by means of the computational procedures of TUNAMI N2 in C++ language and is presented as the user-friendly code for tsunami simulations and visualizations (NAMI DANCE, 2011). The code has been applied to several tsunami events and used in more than 10 institutes worldwide (Zaitsev et al, 2008; Ozer et al, 2008, 2011; Yalciner et al, 2010) and have been improved in Ozer (2012) in order to calculate inundation on land in finer domains more precisely as to overland currents, their directions, discharge fluxes and Froude numbers.

The study domains are determined by gathering several reliable measured and digitized datasets. The bathymetric data is obtained from the multibeam and single beam measurements performed by Office of Navigation, Hydrography and Oceanography which has the finest resolution of about 5m at some locations. The topographic data is obtained from General Command of Mapping with 30m grid size and from ASTER at some locations. The coastline and sea structures are digitized from the Google Earth images sensitively. The buildings are detected and their number of floors are specified from the Google Earth images. The height of the building is added to the topographic elevation at that location in order to obtain the elevation of the roof of the building more reliably.

Figure 2 shows the location of largest domain, Dalaman Domain, and Gocek Domain with the digitized coastline, breakwaters, berthing places and buildings on land on the Google Earth satellite image of the region. It is necessary to locate the marina structures on the map sensitively in order to analyze the current velocities inside the marina and to access the possible damage of the sheltered sea vessels in case of a tsunami event.

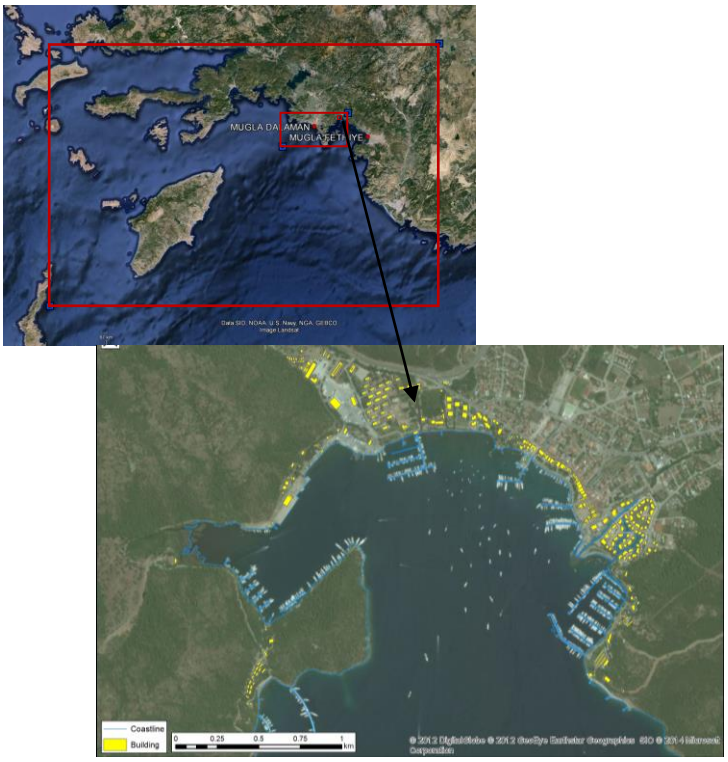

Figure 2: Largest Domain and Dalaman Domain, and Gocek Domain with the digitized coastline, sea structures and buildings on Google Earth satellite image

The numerical modeling is performed by inputting both static and dynamic sources gradually. The first analysis is performed in a larger domain covering the earthquake origin and including the smaller Dalaman domain with 150m grid size and Gocek domain with 3m grid size. In this analysis, numerical gauge points are located along the bottom boundary of Dalaman domain. As well as the maximum tsunami hydrodynamic parameters spatially distributed on the basin, NAMI DANCE can calculate the water surface elevation, discharges fluxes in x and y direction, current velocities and other parameters at the numerical gauge points at every inputted timestep. At the end of this analysis, this data is obtained at one of the numerical gauge point located along the bottom boundary of Dalaman domain in four columns as time, water surface elevation, discharge flux in x and y directions, respectively. In the second step of the analysis, the smaller Dalaman domain is used by using the data at the boundary gauge point as a dynamic input. Likewise, a numerical gauge point is located at the bottom boundary of the smaller Gocek domain. The last analysis is performed in Gocek domain with the finest grid size of 3m including the digitized coastline, sea structures and buildings. In this last step, the inundation maps are created on a finer resolution basin showing the penetration of wave through the streets and pedestrian roads between the buildings and also inside the marina.

As being the end-users of tsunami alert messages disseminated from NTWC, the inundation maps created along the Turkish coasts covering Tsunami Forecast Points will be very beneficial for the local authorities and disaster emergency managements in order to comprise tsunami hazard mitigation strategies and plan the evacuation routes before tsunami waves arrive.

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