Study of hazard levels in relation to tsunamis along the Spanish coastline

The Directorate General for Civil Protection has released the results of a study of tsunami risk hazardousness along the Spanish coastline. This is a preliminary study aimed at developing more in-depth risk management plans and studies at autonomic and local government level, yet which can provide useful information on this thusfar relatively unknown risk.

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Royal Decree 1053/2015 of 20 November endorses the Basic Civil Protection Guidelines on Tsunami Risk. The guidelines establish a need on the part of the Directorate-General of Civil Protection and Emergencies (DGPCE for the Spanish) to determine the hazard level along the Spanish coastline in relation to tsunamis in order to be in a position to find out which are the territorial areas where drawing up specific civil protection plans for such a risk is either essential, advisable or unnecessary.

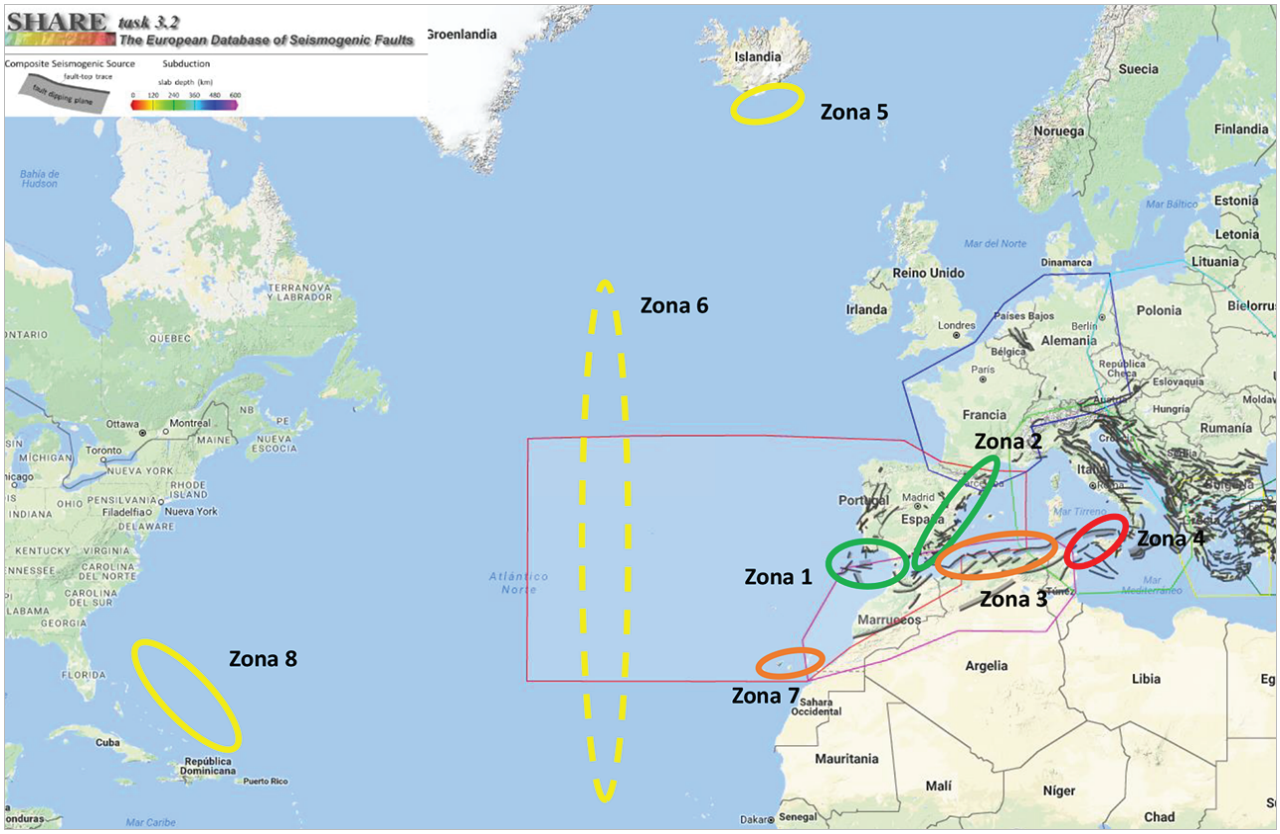
To this end, after organising the relevant call for proposals, the DGPCE commissioned a study of tsunami hazard levels along the Spanish coastline from the joint venture Proes Principia. The DGPCE published the findings[1] in February 2017. This was a qualitative approach to the problem which, despite the short time available to conduct the study, yielded some very interesting results.

Despite limitations which the authors themselves acknowledge, this is a very interesting study which is also to a large extent a pioneering one, of the level of the tsunami hazard in Spain. It will have to be supplemented with others of a more specific and detailed nature and will allow the various autonomic and local governments to make a start on developing their own tsunami emergency management plans.

The study began by using information provided by the Geological and Mining Institute of Spain (the IGME, for the Spanish) to identify faults active in the quaternary period which would be capable of producing a tsunami that affects Spanish coasts. The lower bound on the magnitude scale for an earthquake capable of triggering a tsunami was set at 6.5 and only those faults with normal and reverse rupture traits were picked out, as those are the ones that can cause vertical plate shifting in the seabed. Eight potentially tsunamigenic zones were thus identified:

1. Cabo de San Vicente- Golfo de Cádiz
2. Costa mediterránea española
3. Argelia
4. Sicilia
5. Islandia
6. Dorsal atlántica
7. Canarias
8. Caribe

(1) http://www.proteccioncivil.es/documents/20486/412575/inf_1125Rev1/b818c97f-760f-4954-b73b-c72ebafa36e5

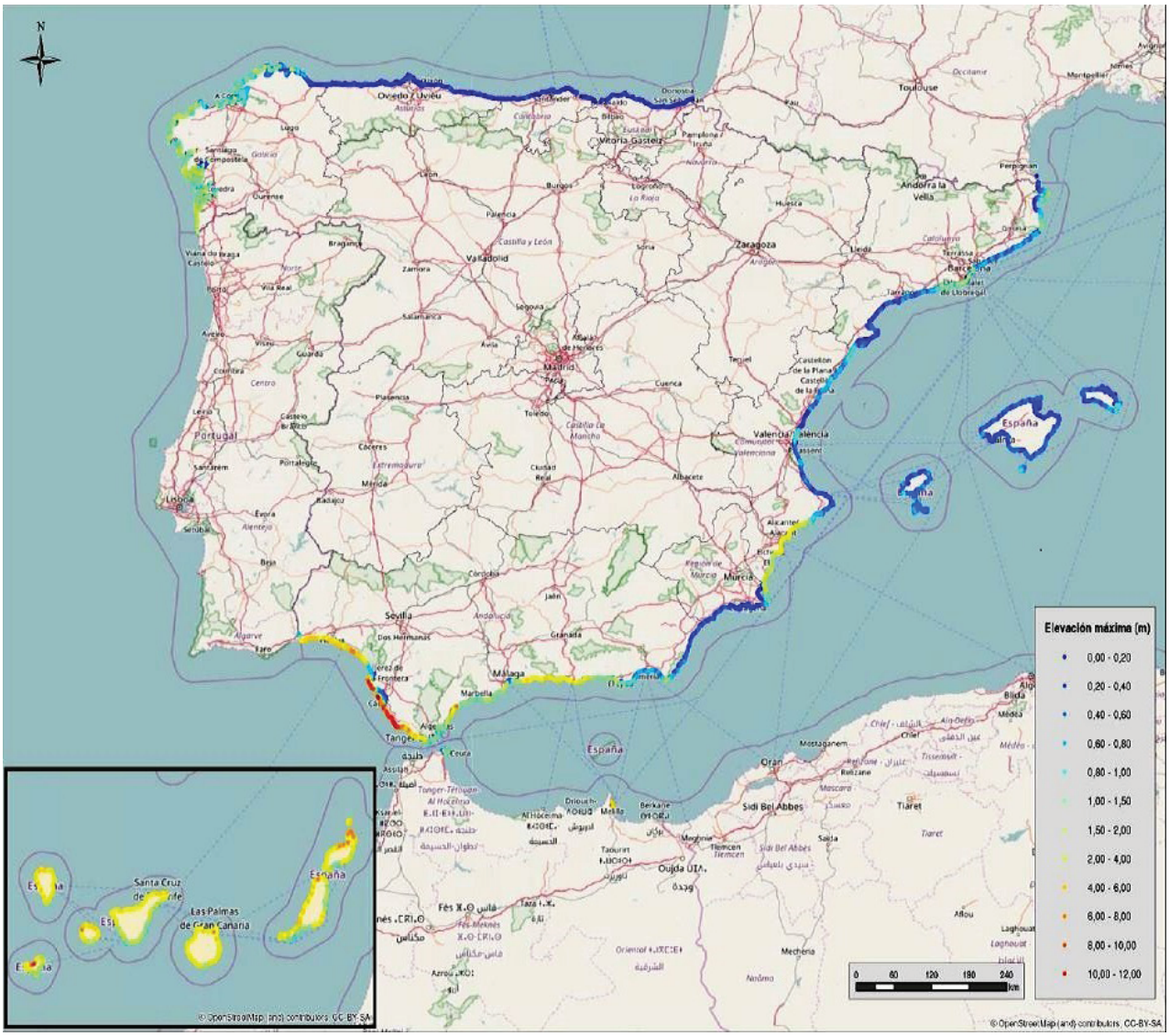


The study was based on a set of initial assumptions (a linear rupture of a fault along the whole of its length) and correlations between earthquake magnitude and plate sliding were used to establish the relationship between the earthquake on the seabed and the subsequent tsunami.

Afterwards tsunamis were modelled using the Delft3d-FLOW numerical model, which allows nested grids to be used, adjustable to the available bathymetries (maps of the seabed) and the necessary resolution. For this phase of the study bathymetric information was used from various different national databases (Directorate-General for Coastal and Marine Sustainability, the Spanish Institute of Oceanography, the Navy Hydrographical Institute and the National Geographic Institute) and international databases (EMODnet and GEBCO) with a different resolution.

Using the seismic and bathymetric information tsunamis were generated with the numerical model referred to and at all times selecting the worst case scenario — for example by integrating the tidal simulation with the tsunami simulations so that the latter always happens at the point of high tide-. The simulations were validated using the estimated effects of the tsunami caused by the Lisbon earthquake of 1755, which is historically the most serious tsunami to have affected Spain.

The end results were incorporated on a general map that shows the highest elevation that, according to this deterministic study and its initial assumptions, could be reached on the Spanish coast by the effect of a tsunami.



The main results are that the highest elevations could occur on the Atlantic coast of Andalusia and in the Canary Islands, at potentially over 8 m and with times taken to arrive of around 1 hour. On the east coast of Andalusia too there could also be tsunamis of up to approximately 5 m and arrival times of the order of 20-30 minutes. Along the rest of the Mediterranean coast and in the Balearic Islands there could be tsunamis of roughly as high as 1-2 m from various different sources and others, of a more local nature, caused by small faults that lie very close to the coast, with maximum heights of this order, or a bit higher, but with practically instantaneous arrival times. Along the Atlantic/Cantabrian coast, only in Galicia could tsunamis reach a height of 2 m, which would be generated by earthquakes with a high magnitude in zone 1 and have arrival times of over 1 hour. Along the rest of the Bay of Biscay coastline tsunamis are not expected to exceed 50 cm, while their arrival times would be in the region of several hours.

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