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Letter

WebGIS for Italian tsunami: A useful tool for coastal planners

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ABSTRACT

RITMARE is the Italian contribution to a sea research program promoted by the European Commission aiming to create an integrated maritime policy. In this context a geodatabase about tsunami events recorded along the Italian coasts, as reported in recent scientific papers, has been realized. Each scientific paper occurring in the geodatabase is linked to its area of interest by means of a Geographical Information System (GIS). The geodatabase is available on the RITMARE website (www.ritmare.it) through a map server.

1. Introduction

During the recent years in Italy, as well as in other countries, the increased occurrence of extreme events such as storms and floods enhanced a policy for the monitoring of environmental dynamics. This is particularly true for the coastal zone that has become more and more vulnerable, due to the growing population and productive activities that cluster along the shoreline.

With the publication of the Blue Paper '*An integrated maritime policy for the European Union*' (COM 2007/575 of 10 October 2007), the European Commission underlines the need to create a systematic research on the sea by integrating research resources and innovation in the maritime field. In this context Italy has produced RITMARE, the Italian Sea Research program for scientific and technological research on marine and maritime issues. The program is divided into seven sub-projects included in the "Flagship Projects" of the National Research Program of 2010–2012. Furthermore, RITMARE is a partnership between public research authorities, and is coordinated by the National Research Council and the National Maritime Technology Platform (www.cnr.it).

In particular, a reference list of scientific papers concerning tsunami events that occurred along Italian coasts has been realized under the program's sub-project SP3 – Coastal Range > WP3 – Strategies for the observation of events > Action 2 > UO02 – "Deterministic assessment of tsunami hazard on the coast of Southern Italy". Scientific contributions have been collected from available digital libraries, and they have been arranged according to the area of study and inserted into a geographic database. This geodatabase is managed by a Geographic Information System (GIS) and is available via map server on the site of the RITMARE program (www.ritmare.it).

According to the National Oceanic and Atmospheric Administration/World Data Center (NOAA/WDC), 63% of the recorded tsunami events affected the Pacific Ocean, followed by 21% affecting the Mediterranean Sea, 6% impacting the Indian Ocean and 5% in the Atlantic Ocean (Mastronuzzi et al., 2013). The particular geodynamic context of the Mediterranean basin and the geographic position of Italy make this region prone to tsunamis generated in different areas of the Mediterranean Sea. Despite a certain reluctance of the scientific world to consider tsunamis as a real factor of risk, recent historical and geomorphological studies reconstructed a long list of events that struck Italian coasts. Only in the last two decades historical research (i.e. Guidoboni and Tinti, 1987; Guidoboni and Comastri, 2007) and geophysical models (i.e. Tinti et al., 1997; Piatanesi et al., 1999) were integrated by geomorphological field surveys that allow (ì) deposits and landforms produced by the impact of tsunamis to be recognized, and (ìì) the reconstruction of past events sequence (Mastronuzzi and Sansò, 2000; Gianfreda et al., 2001; De Martini et al., 2003; 2010). In fact, the impact of a tsunami on the coast produces a number of morphological and sedimentological evidence in function of its magnitude as well as the morphological and litho-structural coastal features. A critical analysis of this evidence may contribute to the assessment of potential future coastal hazard and risk scenarios (Mastronuzzi et al., 2013). So, the proposed WebGIS

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should be a valuable tool to individuate scientific papers related to tsunamis that hit different coastal areas of Italy. Copyright doesn't allow to supply directly the paper of interest, but areas for which contributions are available can be easily detected. Unluckily, at present the most part of the scientific contributions deals with geodynamics and geophysics; this appears in contrast with the deterministic approach invoked by the research program but, at the same time, it suggests a probabilistic hypothesis that needs to be verified in the field. Moreover, historical data are often extracted from the data set proposed by Tinti et al. (2004), notwithstanding that an important amount of information are available on the INGV (Istituto Nazionale di Geofisica e Vulcanologia) website (http://roma2.rm.ingv.it/it/risorse/banche_dati/27/il_catalogo_dei_maremoti_italiani).

2. WebGIS implementation

The first step for the WebGIS implementation was the screening of scientific papers available in electronic libraries (www.sciencedirect.com, www.periodici.caspur.it) and specific digital editors (www.nat-hazards-earth-syst-sci.net). Papers published before 1990 have been excluded from the reference list since they are generally not easily available on the web.

References reported in each publication have been used to identify other papers that were not collected in the first research. The identified articles were then sorted in function of the studied areas and subdivided into five categories: Geology, Geodynamics, Hydrodynamics, Geophysics, and History Archive. The next step was to associate each paper to the geographical information, i.e. the latitude and longitude of the area's representative point, which can easily be managed by means of a Geographical Information System (GIS). The resulting geodatabase has been published on line as WebGIS, via map server.

In the GIS project, papers are records of a point vector theme whose attributes table has the following fields: *i* – ID: an integer in ascending numerical order assigned to every article; *ii* – X and Y: respectively Longitude and Latitude expressed in decimal degrees (WGS84); these geographical coordinates were determined for the sites studied in scientific papers and where papers reported more than one surveyed site, a point was assigned to each of those sites; publications covering the entire national territory have been referred to the geographical coordinates of Rome; *iii* – YEAR: year of publication; *iv* – AUTHORS; *v* – TITLE: the article title; *vi* – JOURNAL: name of the journal in which the article is published, including pages and volume number; *vii* – SCOPE: disciplinary field; *viii* – KEYWORD: keywords provided by authors or attributed based on the strength of matter; *ix* – ABSTRACT: the abstracts of the articles, first copied in alphanumeric format and then saved in .jpeg format to be uploaded into an image hosting site (www.imageshack.us) that generated a link for each .jpeg file which was then inserted in the "ABSTRACT" column.

The WebGIS is available on the RITMARE website in the section: Action 2 (http://www.ritmare.it/articolazione/sottoprogetto-3/sp3-wp3/sp3-wp3-azione-2). Each paper is represented on the map by a point whose color marks the category. Through the "*Get Feature info*" function and a click on an interest point on the map, a pop-up window appears showing the attribute table containing information associated with that specific paper (Fig. 1).

3. Discussions and conclusions

The Mediterranean basin is characterized by continuous tectonic activity due to the complex convergence of the African plate with the Euro-Asian plate (Chiarabba et al., 2005; Anzidei et al., in press) responsible for volcanic and seismic activity both in emerged and submerged areas. The peculiar geodynamic context explains the generation of several tsunamis that struck in the recent past the coastal areas of southern Italy (Mastronuzzi et al., 2013). The following examples only suggest the different processes that can produce such destructive waves. The

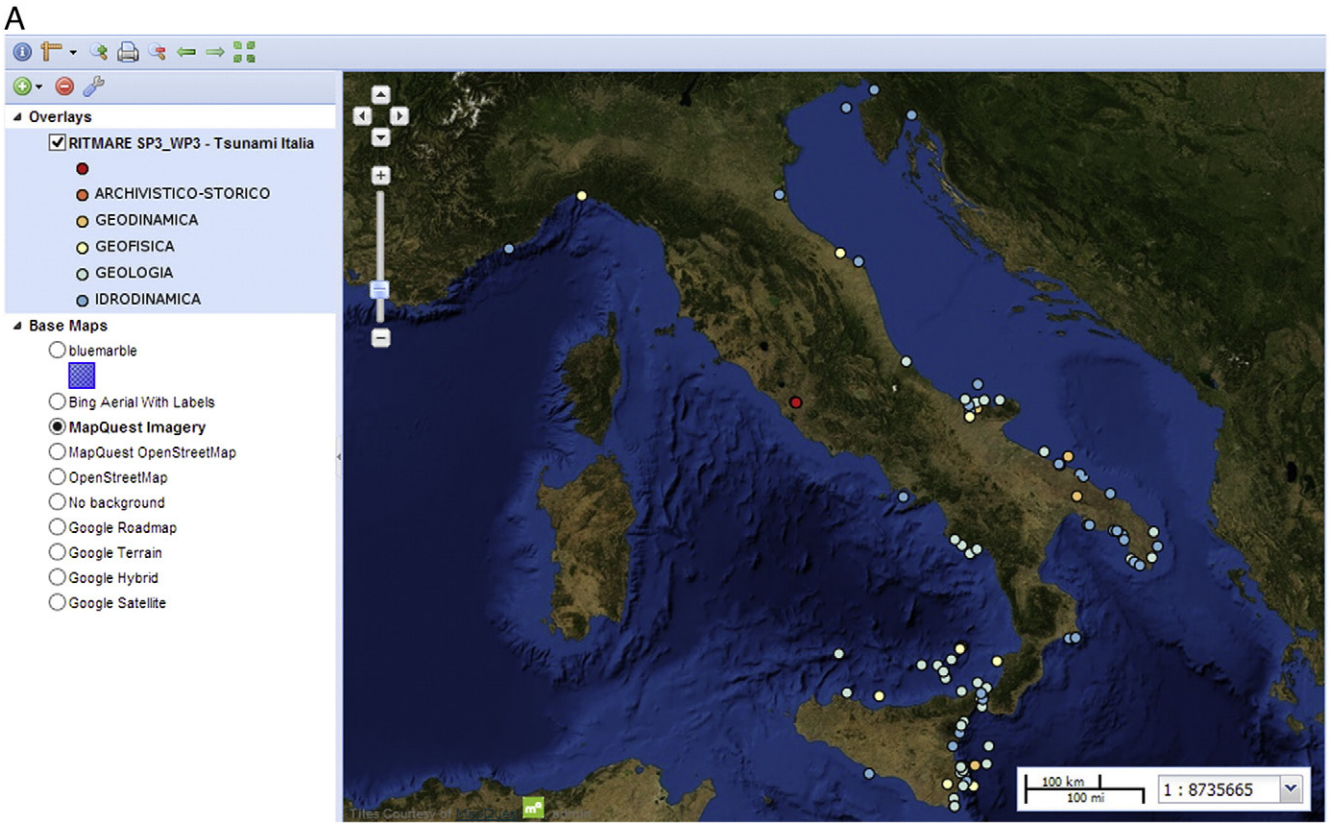

Fig. 1. Screenshot of Tsunami-Italia WebGIS on the RITMARE website. A) Base map courtesy of MapQuest©; B) Pop-up window showing the attribute table of the interest point. This specific pop-up window displays data of Maramai et al. (2005) (B1) and the abstract (B2).