Probabilistic TSUnami Hazard MAPS for the NEAM Region (TSUMAPS-NEAM)
ECHO/SUB/2015/718568/PREV26
Final Progress Report - 29 November, 2017

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2. Project objectives, partnership and expected deliverables.

Title of the project: Probabilistic **TSU**nami Hazard **MAPS** for the **NEAM** Region. Acronym: **TSUMAPS-NEAM**. TSUMAPS-NEAM is a Prevention Project, Priority 3, External Budget item. The total duration of the project is **21 months**.

This report considers activities carried out in the third, seven-month-long period of the project, i.e. from **01/03/2017** to **30/09/2017**, months 15-21.

A region-wide long-term homogenous probabilistic tsunami hazard assessment (PTHA) from earthquake sources was not available before this project. TSUMAPS-NEAM's general objective was to fill this gap. This PTHA should serve as a basis for future national and local PTHAs and be the first step to include tsunamis in multi-hazard risk assessments. The specific objectives of the project were tackled by the following four consecutive actions: 1) designing the methodology and producing a state-of-the-art, standardized, and updatable PTHA with full uncertainty treatment; 2) reviewing the entire process with international experts; 3) producing the final PTHA, its online database and maps, and the documentation of the followed procedures; and 4) publicizing the results through an awareness raising and education phase, and a capacity building phase, particularly oriented toward Enlargement and Neighbourhood Policy countries.

Partnership:

INGV	NGI	IPMA	GFZ	METU	UB	NOA	CNRST	INM
Italy	Norway	Portugal	Germany	Turkey	Spain	Greece	Morocco	Tunisia
Member State	Participating State	Member State	Member State	Enlargement	Member State	Member State	Neighbourhood Policy	Neighbourhood Policy

The partnership of the project included research institutions established in EU countries, as well as in Enlargement and Neighbourhood Policy countries, spread all across the European continent with coastlines facing the NEAM Region, and bearing significant exposure to potential tsunami hazard. Further potentially threatened countries were included as end-users, or by involving key-advisors with roles in the Intergovernmental Oceanographic Commission (IOC/UNESCO) Tsunami Program and representative of the Tsunami Service Providers (TSPs) in the NEAMTWS.

Expected deliverables are listed below with month of delivery indicated in parenthesis, and deliverables in this reporting period in bold: D1, First Progress Report (M9); D2, Second Progress Report (M16); **D3, Final Progress Report** (M23); D4, Online Tsunami Hazard Database (M14); D5, Tsunami Hazard and Probability Maps (M14); **D6, Experts' Review and**

Sanity Check (M18); **D7, Methods and Data Documentation** (M18); D8, Project Website (M4); **D9, Awareness and Education Materials** (M16); **D10, Guidelines and Training Tools** (M19); **D11, Layman's Report** (M21).

3. General summary of project implementation process

The project was conceived as a cascade of activities, subdivided in four tasks (A-D). Task A was devoted to project management and reporting. Task B was devoted to setting up a probabilistic hazard model, which also included: an elicitation of experts (the "Pool of Experts", PoE, was formed by fifteen scientists, eight of which selected among the partners and seven from the international community) to make critical choices and to assign weights to alternative models, as well as a thorough peer-review process (performed by twelve "Internal Reviewers", IR, different from the PoE). Task C performed sanity checks and documentation of the calculations. Task D carried out publicity and dissemination, and particularly, built the public interface with the results of Task B.

Most of the scientific framework, input data and part of the technical platform for the hazard assessment were based on resources already acquired by partner institutions (including but not limited to EU-funded projects). Most importantly, part of the work was carried out in collaboration with the EU FP7 ASTARTE project. A significant part was also developed with the support of the Italian Civil Protection Authority in the framework of an agreement with INGV for tsunami hazard. Therefore, the efforts to pursue the project-specific objectives relied mainly on human resources (personnel) and the need of frequent meetings to ensure the collaboration of the various specialists and the coordination of activities.

4. Evaluation of project management/implementation process

The cooperation among the institutions forming the partnership was very fruitful and seamless. Likewise was the ongoing collaboration with other projects and initiatives, primarily with the ASTARTE EU project, but also with other organizations such as the Global Tsunami Model (GTM) and IOC/UNESCO.

The project management had to address the cooperation with some institutions and individuals that had only limited previous collaboration in EU projects. To this end, face-to-face meetings have been an excellent way to deal with this issue and strengthen the collaborative attitude of all partners toward a common goal. Several further meetings were held remotely, by teleconference, in order to save funding from travel to the benefit of personnel. This is particularly evident in the budget transfer between these two categories, and in the increased budget to GFZ for supporting more personnel.

5. Activities

This reporting period was the most intense in terms of activities devoted to the actual PTHA implementation. Most of the deliverables concentrated in this period, including the interaction with PoE and IRs. The progress in each task was checked by reaching several milestones, which coincide with six major meetings.

1) The ASTARTE project final meeting held on 06-07/04/2017 in Mallorca, Spain, allowed discussing critical elements in view of the preparation of the period's deliverables and strengthening the collaboration between the two projects in practical terms.
2) The EGU General Assembly 2017, held in Vienna, Austria, on 24-28/04/2017, was the ideal venue for presenting the project to the scientific community at large. A splinter meeting was held on 26/04/2017 to discuss the project progress. The participation at the GTM splinter meeting on 25/04/2017 reinforced the connection with the GTM network.

3) A technical meeting held in Rome, Italy, on 12-13/06/2017 to finalise the hazard model implementation, from calculations to output and display in Internet.
4) The project final meeting held in Tunis, Tunisia, on 11-12/09/2017, to consolidate the project results, raising awareness and improving risk understanding in the NEAM Region by dissemination and building local capacity on the methodology, the interpretation, and the use of regional PTHA, with the involvement of ALECSO to improve knowledge transfer to neighbourhood-policy countries. Direct personal meetings with PoE members, IRs, end users, and stakeholders took place as well.
5) Participation at the IOC/UNESCO Information Meeting held in Tunis, Tunisia, on 13-14/09/2017 on NEAMTWS and Mitigation System, as well as the NEAMWave 17 Tsunami Exercise, emphasizing the complementarity between NEAMTWS and regional PTHA.
6) Participation at the IOC/UNESCO Information Workshop on NEAMTWS held in Madrid, Spain, on 25-26/09/2017 where the project results were presented.

This period of the project was mainly dedicated to consolidating the hazard assessment effort. This involved incorporating input through PoE's elicitation, from the IRs, and collecting feedback from end users and stakeholders. Activity has proceeded on all tasks. Importantly, the results of the elicitation, the documentation of the review, and sanity checks were extensively discussed in the Tunis Meeting of 11-12/09/2017, with the presence of several IRs and PoE members.

6. Presentation of the technical results and deliverables

The technical results consolidated in this period are represented by the PTHA, summarized as follows: hazard curves calculated at 2,343 POIs (North-East Atlantic: 1,076; Mediterranean Sea: 1,130; Black Sea: 137) at an average spacing of ~20 km; for each curve, hazard values for mean, 2nd, 16th, 50th, 84th, 98th percentiles; probability maps for Maximum Inundation Heights of 1, 2, 5, 10, 20 meters; hazard maps for Average Return Periods of 500, 1000, 2500, 5000 years; and for each map hazard values for mean, 16th, 84th percentiles. An Interactive Hazard Map and Curve Tool was finalised as well, to display, consult, and download these data.

Below is a short description of each of the deliverables of this third reporting period.

Deliverable D3 corresponds to the final progress report (this document).

Deliverable D6, Experts' Review and Sanity Check (M18), consist of the guidelines for reviewers, a report on sanity checks, and the response received from the reviewers.

Deliverable D7, Methods and Data Documentation (M18), is composed by the documentation sent to the reviewers in May-June 2017, including D6 and the results of the elicitation experiments. This material will be updated with the final documentation to be prepared for publication after the project's end.

Deliverable D9, Awareness and Education Materials (M16), is composed by brochures, factsheets, a newsletter, and videos shown in various occasions, especially at the final meeting in Tunis. This material will be updated with the images and description of the final results for publication after the project's end.

Deliverable D10, Guidelines and Training Tools (M19), consist of a user manual and tutorial video for instructing users on how to use the online Interactive Hazard Curve Tool.

Deliverable D11, Layman's Report (M21), is a description of the project and its results for a non-technical audience to be distributed through the project website and in print at meetings.

7. Evaluation of the technical results and deliverables

The current hazard assessment results from multiple rounds of calculations performed after incorporating the input from the PoE, the IRs, and the end-users, and from running sanity

checks and sensitivity tests on most parts of the workflow. One of the main strengths of this effort was the involvement of the international community in a participatory manner, through the PoE and the IRs. GTM provided several IRs and PoE Members. The main project outcome - the probabilistic tsunami hazard model, in the form of curves and maps, - is now ready for publication online. Particular care should be devoted at the follow-up activities for and effective dissemination of the results achieved and for getting feedback on the hazard model.

8. Follow-up

Most of the time and resources of the project were dedicated to obtaining the probabilistic tsunami hazard assessment in a transparent and reproducible way. Dissemination activities were devoted at making the project known to a wide audience. The follow-up activities will thus be dedicated to consolidation, curation, and dissemination of the hazard results.

Starting on December 2017, the online Interactive Hazard Curve Tool will we open to the public for a three months moratorium during which we expect to receive feedback from the designated reviewers (i.e. second review of the assessment workflow), and from our end users, stakeholders, and the general public. To this end, an *ad hoc* questionnaire will be sent to a pool of designated parties by e-mail and the results made available later on in the project website. After this moratorium period the hazard results and the online tool will be definitely fixed and protected from any changes. In the meanwhile, an additional effort will be made to ensure a proper distribution of the hazard results. The hazard files will be distributed using OGC standards through the "*tsunamidata.org*" platform set up at INGV (http://www.tsunamidata.org/), including the distribution of metadata in the INSPIRE compliant ISO 19139 standard, the minting of a DOI for traceability of usage and warranty of the integrity of files, and the attribution of a Creative Commons license. These additional steps are needed for seeking interoperability with other hazard and risk products, such as those in the European platform for seismic hazard EFEHR (http://www.efehr.org/), in view of multi-hazard developments.

Other initiatives for dissemination include: (i) Publication of the project results in scientific journals with at least one paper about the overall project and its results, and some other papers about specific aspects of the work done; (ii) Participation at meetings and dissemination of educational material, including the following upcoming events: the 36th GNGTS annual meeting, in Trieste, Italy, 14-16/11/2017; the 14th Session of the ICG/NEAMTWS, in Lisbon, Portugal, 21-23/11/2017; the AGU fall meeting, 11-15/12/2017 in New Orleans, USA; and the 6th Civil Protection Forum "Civil Protection in a Changing Risk Landscape" in Brussels on 05-06/03/2018.

In addition, some project's by-products could also be shared with the tsunami community, such as, a large database (c. 30 Terabyte) of pre-calculated tsunami scenarios for over 120,000 elementary sources covering an area of c. $6x10^6$ km^2; a hazard calculation platform; and amplification factors for estimating the maximum inundation height.

Another follow-up action will consist in proposing the TSUMAPS-NEAM approach as a reference for PTHA to a wider audience. This goal can be pursued through the GTM (http://www.globaltsunamimodel.org/), which is endorsed by UN-ISDR and GFDRR in the spirit of the Sendai Framework for Disaster Reduction 2015-2030, and through the EPOS-Seismology community (https://www.epos-ip.org/tcs/seismology). These initiatives will contribute to promote the EU as one of the main players in the international effort toward the creation of global standards and good practices for tsunami hazard assessment and risk mitigation.