

## Form T1 – Description of the action – Annex I

Title of the project	Probabilistic TSUnami Hazard MAPS for the NEAM Region (TSUMAPS-NEAM)
Prevention or preparedness	Prevention
Priority covered	3
Internal or External	External

### SUMMARY OF THE PROJECT

#### 1. Summary of the project\*

Tsunami risk assessments and warning systems need Probabilistic Tsunami Hazard Assessment (PTHA) as input and reference. TSUMAPS-NEAM will develop the **first homogeneous long-term PTHA for earthquake-induced tsunamis**, which is **presently unavailable for the coastlines of the NEAM region** (NE Atlantic, the Mediterranean, and connected seas). Similar initiatives are presently shaping in USA, Indonesia, and under the UN-ISDR for the HFA completion and 2015-2030 SFA implementation. TSUMAPS-NEAM will largely rely on input from the EU FP7 project ASTARTE, of the GAR15 (global risk quantification under the HFA), and national PTHAs like those of USA and Italy. TSUMAPS-NEAM will also promote an informed process of **outreach, guidelines definition, and capacity-building initiatives especially targeted at EU Enlargement and Neighbourhood Policy countries involvement**. These actions will also strengthen the connection between Candidate Tsunami Service Providers (CTSPs), Civil Protection Authorities (CPAs), JRC and ERCC, thus reinforcing NEAM Tsunami Warning System (NEAMTWS) effectiveness for the last mile. The regional PTHA is also meant to be the term of comparison or a basis for existing or future national PTHA efforts. Common risk assessment, long-term risk mitigation and planning, at the national and regional levels, and several specific applications (e.g. land-use and evacuation plans, identification of Critical Infrastructures (CIs) at risk) will also benefit from having a region-wide PTHA as input and reference. Therefore, this PTHA will rely on common understanding of the best viable practices and comply with EU scientific and policy standards for hazard and risk assessment (e.g., seismic hazard for building codes). Moreover, the development of standardized PTHA products (hazard and probability curves, maps, documentation, web-tools for their analysis) is the first step to include also tsunamis in multi-hazard risk assessments.

\*Please find at the end of this form a list of all acronyms used in TSUMAPS-NEAM proposal

## 2.Objectives

The general objective of TSUMAPS-NEAM is two-fold: **produce the first region-wide long-term homogenous PTHA for NEAM; trigger a common tsunami risk management strategy in the region.** The first objective is clearly a tool for achieving the second one. The technical cooperation (**analysis**) process initiated within ASTARTE will be transformed into a homogeneous regional **assessment**. Coarser scale UN-ISDR GAR15 results will be a term of comparison. The results will be transferred to the hazard governance system (e.g., CPAs, local authorities, decision makers) through the broadest possible involvement of relevant actors. The specific objectives can be described as a cascade of four consecutive actions: 1) state-of-the-art, standardized, updatable, **Assessment**, with full uncertainty treatment; 2) **Review** process with international experts; 3) **Production** of the PTHA database, with documentation of the hazard assessment procedures and dynamic web-based interface; 4) **Publicity** through i) an **awareness raising and education** phase, and ii) a **capacity building** phase. Publicity will be particularly oriented toward Enlargement and Neighbourhood Policy countries. A homogeneous and region-wide PTHA will fill the existing gaps for a common and cross-border hazard assessment, based on sharing of data and good practices. Public risk awareness will be increased, and specific expertise made accessible to specialists through documentation, guidelines, and web tools. TSUMAPS-NEAM will also complement similar efforts at national level (e.g. Italian PTHA INGV-Italian CPA agreement) or the existing standardized products for other hazards (e.g. SHARE, STREST, MEDSUV EU FP7 projects, national projects), then allowing end users, stakeholders, and risk practitioners, to include tsunamis in a multi-hazard risk framework, in order to improve risk assessment and management planning (early warning and long-term) at all governance levels. The results will be further utilized in the UN-ISDRs GAR towards the SFA 2015-2030 priority 1 (understanding disaster risk).

## 3. Expected results

The expected results are: 1) **long-term PTHA** (complete *hazard curves*), i.e. exceedance probability for different runup or wave-height thresholds (the exact definition and nomenclature for the impact metric will be discussed within the project), at points distributed along the NEAM coasts; 2) **regional hazard maps** (hazard intensity with given exceedance probability, e.g. for sizing of shelters, design/reinforcement of buildings and CIs); 3) **probability maps** (probability corresponding to given intensities, e.g. for selecting tolerance levels for mitigation actions, evacuation planning, locating CIs); 4) **website** for sharing information on activities, documentation, data, results; 5) **technical documentation and guidelines**, on data analysis and PTHA methods; 6) awareness-raising **materials** (website, printed materials, contents for media, glossary), and capacity building **tools** (web-based analysis tool; guidelines; meetings with stakeholders and authorities). In particular, the final TSUMAPS-NEAM meeting will be held in a Southern Neighbourhood Policy country. We will **immediately**: develop a common approach to PTHA; increase awareness of authorities, stakeholders, media, and general public; diffuse expertise among scientists and authorities of Enlargement and Neighbourhood Policy countries. In the **medium-to-long term**, we favour: research on uncertainty reduction and continuous PTHA update; cross-border diffusion of a knowledge-base for local risk assessments, toward land-use/evacuation planning, tsunami building codes, identification of exposed CIs. The

combination of awareness raising and base-knowledge sharing with CPAs, will enhance the interaction between CTSPs and local authorities, thus making NEAMTWS more effective.

#### 4. Final beneficiaries

The TSUMAPS-NEAM Observers' Board (OB; composed by Institutions / Organizations / Experts acting as end users or advisors; see all letters of support enclosed), will be established for getting continuous feedback on both the scientific and publicity activities, and on the requirements of relevant stakeholders. Note that some partners play also an end user role (because they are CTSPs or are involved as Neighbourhood countries in the capacity building process). Many end users and advisors are also involved in the UNESCO Tsunami Program, through: **IOC/UNESCO** itself, responsible for the coordination of CARIBE-EWS, IOTWS, NEAMTWS, and PTWS; the **CARIBE-EWS Chairperson** (NOAA); a vast representative of the **ICG/NEAMTWS**, through the Chair (METU), one Vice-Chair (through DPC, the Italian CPA), the IOC/UNESCO Secretariat, and several SC Members (INGV, NOA, IPMA, DPC); **four of the five NEAM CTSPs** (Greece, NOA; Italy, INGV; Portugal, IPMA; Turkey, KOERI). Note that one CTSP is from an **EU Enlargement country**, Turkey. Acting as end users/advisors or as partners there are also: **three EU Neighbourhood Policy countries**, namely, Egypt (NIOF), Morocco (CNRST), and Tunisia (INM). The OB is completed by representatives of **USA** (USGS, NOAA) and **Russia** (SRB-RAS), by the **EU Joint Research Centre Institute for the Protection and Security of the Citizen** (JRC-IPSC), and by **EPOS**, which is a priority project in the ESFRI roadmap for implementation. Furthermore, **relevant CPAs** have been informed (Italy, enclosed form A8, Portugal, Spain, Norway, Germany, and Greece). The results are also of interest for **2015-2030 UN-ISDR SFA implementation**. Accordingly, several contributors to GAR15 PTHA are involved in the Consortium (NGI, IPMA, and INGV) or are advisors (USGS).

#### 5. Methodology/Organizational structure

The TSUMAPS-NEAM PTHA for earthquake-induced tsunamis, which are the vast majority, will apply good practices emerging from previous efforts and high-quality standards. This will be secured through the presence in TSUMAPS-NEAM of: ASTARTE PMB and PTHA scientists; contributors to GAR15, national PTHA projects, seismic hazard projects (e.g. SHARE, GEM, national hazard maps); designation of an international peer-review panel, including members of the OB; and of a Pool of Experts, which will assist through an elicitation in weighting different modelling alternatives. We will use: 1) a statistical treatment of potential sources, combining all the available information (seismicity, moment tensors, tectonics), and considering both earthquakes occurring on major crustal and subduction faults and the diffuse background seismicity; 2) a computational approach to tsunami generation and linear propagation up to an offshore fixed depth; 3) well-established regional approximations for shoaling and inundation, and for tidal stages; 4) ensemble uncertainty quantification. The presence in the Consortium or as end users of four EU Enlargement and Neighbourhood Policy countries; of Russia, IOC/UNESCO, four of the five NEAMTWS CTSPs, and JRC, will tremendously facilitate awareness raising and capacity building initiatives. Most of these actors will be stimulated to play an active role in both PTHA results analysis and outreach activities, in order to build common good practices

for understanding risk. Experience of CARIBE-EWS in the Tsunami Ready program will be an asset in this respect. Interaction with all the other relevant actors and stakeholders will be achieved both through web-based dissemination and training tools, and through dedicated meetings. Along with method documentation and guidelines, these will facilitate the reinforcement of common risk mitigation strategies.

## 6. Implementing partnership and project team

TSUMAPS-NEAM consists of nine partners covering the NEAM region. TSUMAPS-NEAM implementation will be as follows (Definitions of Tasks (A-D) and Actions in form T2, and in Gantt chart, form T3). **Task A.** INGV (Coordinator), responsible of Actions A.1-A.2. A.1 is performed by the Steering Committee (SC): Coordinator, A-D Task leaders, and the ASTARTE PMB (IPMA, METU, and UB). SC ensures inter-Task cooperation and communication with ASTARTE. End users and advisors form the Observers' Board (OB), which supervises and interacts with all Tasks. UB assists INGV in the A.2 activities. **Task B.** INGV and IPMA are responsible of B.1-B.4. Collaborators in B.1 are NOA, GFZ, METU, UB, CNRST, i.e. those with seismology background and knowledge of relevant seismic regions. Collaborators in B.2-B.3 are the tsunami and hazard modellers (NGI, GFZ, and METU). B.4 is about results aggregation and analysis, and includes all partners and the OB (also through periodic teleconferences), to facilitate the widest knowledge sharing. **Task C.** GFZ and NOA are Responsible of C.1, C.2, and C.3. INGV and IPMA participate to the three actions to reinforce necessary interaction with Task B, and UB coordinates the revision (C.2-3) and an external peer-review panel including OB members. **Task D.** D.1-D.2 responsible is METU. IPMA, INGV, CNRST, and INM collaborate in D.1, and the same plus UB in D.2. As for B.4, relevant OB components will be involved as advisors based on their specific experience or as end users (including CTSPs and CPAs), in order to achieve the maximum diffusion of good practices, standards, and results. Some of the dissemination materials, and the web site/web tool implementation will be subcontracted to professionals, in order to ensure high technical and communication standards (see form T3).

## 7. Monitoring and risks mitigation

The project will last 21 months; the first two thirds are mainly dedicated to hazard assessment and review (**Task B**); the second half to dissemination (**Task D**). Task B heavily relies onto previous methods and analyses in ASTARTE, and its dedicated infrastructures. **ASTARTE PMB** participates in the TSUMAPS-NEAM SC, and most **partners in Task B are also ASTARTE partners**. Hence, the **most common risk of delays** is minimized. A back-to-back meeting is then scheduled on occasion of the ASTARTE final meeting (October 2016, postponed to April 2017) for mutual benefit. Both Tasks will also benefit from the already established positive collaborations (e.g. GAR15) among partners. Another **risk element** is the **dependence of Task D from quality, reliability, and timely delivery of results in Task B**. SC will oversee the integration of the activities, deliver to the Commission, and dissemination of the results to end-users and stakeholders. **Progress reports** will be required from each partner and **discussed in technical review meetings**. To encourage cost-effective frequent interactions, teleconferences will be done at all levels. Other meetings

will be arranged in connection with conferences involving the international tsunami community (e.g. EGU, AGU). Quality and reliability will be also assessed by peer reviews, and the PTHA will be revised accordingly. Effectiveness of dissemination will be granted by strict interaction with the OB, which includes the necessary expertise and a variety of relevant end users (see Section 4), and by the fact that some **partners host a CTSP**. **In particular, the risk of poor dissemination and capacity building towards EU Enlargement and Neighbourhood Policy countries is minimized by the inclusion of their representatives and of UNESCO either in the consortium or in the OB.**

## 8. Evaluation

A specific Task (C) is devoted at evaluating both qualitatively and quantitatively the **PTHA** outcomes. It will conduct review and sanity check of products realized by Task B and Task D with **support and advice from external experts**. In particular, experts from the OB (e.g. USGS, SRB-RAS, JRC, and KOERI) and **peer evaluation** by experts with top-notch reputation in the scientific community will provide reviews of the hazard assessment (Task B). A **technical review meeting**, involving all external experts, is scheduled at **M6** leaving enough time afterwards for **reinforcing potential weaknesses**. Task C is specifically dedicated to coordinate these review activities, and to perform **sanity check of PTHA** results. Feedback from the larger community will also be sought by participating in relevant sessions at international conferences. As regards **Publicity** (Task D), the effectiveness of the actions will be evaluated by **continuously interacting** with dissemination/awareness raising experts (NOAA/EWS-CARIBE, IOC/UNESCO) and by collecting **feedback** from end users (CTSPs of the NEAM region, CPAs, JRC, Enlargement and Neighbourhood Policy countries, EWS-CARIBE, and Russia), all within the OB, in two occasions: the **technical review meeting** and the ICG/NEAMTWS XIII meeting in the presence of UNESCO Member States Delegations. A final capacity-building meeting will be held on the premises of one **Southern Neighbourhood Policy country** partner. **Task A** will gather data on project expenditures through **internal financial reporting at month 7, 14, and 21**, and will synthesise information for understanding the potential jeopardy onto the project development (e.g. cost eligibility; assessment of equipment depreciation; rate of expenditures versus project activity progression) and develop countermeasures.

## 9. Cost efficiency and value for money

A tsunami is a natural hazard spanning large areas (even entire oceans) and crossing national borders. The need to investigate large areas translates also into large computational costs. It is also necessary to characterize a great number of source regions. Differently from other natural hazards (e.g. earthquakes, floods, landslides) that can be treated at the local scale, tsunami hazard and its communication to interested parties is typically transnational and multidisciplinary. This project aims at providing a product that can hardly be realized by a single or just few agents both in terms of **knowledge and material resources** (input data, high performance computing, and multilingual/multicultural community). The TSUMAPS-NEAM partners, with their complementary expertise and local knowledge, experience with large cooperation research

projects, infrastructure, and through sharing of best practices and basic knowledge, can produce consensus results that could not be achieved individually; these includes the involvement of several non-EU countries in the entire process. End users (CPAs, decision-makers) will benefit from a product (PTHA) resulting from the **synergetic actions** of a large community. The project cost plan takes also into account that **equipment, methodology, and background material are partly inherited from previous projects** (see Section 5). An added value for CTSPs is that the unit-source tsunami database, which covers the entire NEAM region, could be used also for warning activities. The **cost of the Publicity is minimized** because METU combines experience in dissemination with scientific expertise thereby minimizing the cost of knowledge transfer between Tasks B and D.

## 10. European dimension

Run-up of earthquake-induced tsunamis has a regional dimension. Hence, risk mitigation firstly requires linking regional hazard assessments to mitigation strategies. National and local assessments need to take into account the general picture and the far-away tsunami sources. In this perspective, the primary input to successfully developing risk management policies at European level and beyond (Enlargement and Neighbourhood Policy countries) is a common, standardized and homogeneous PTHA, involving most of NEAMTWS partners and related CTSPs and CPAs, along with trans-border agreement for best-practices, standards, regional data sharing, capacity building and regional dissemination of standards and results. Collaboration among partners is essential in the production of common PTHA based also on national seismic data, local bathymetries, etc. TSUMAPS-NEAM will provide the framework and the opportunity for the partners to unite their experience, develop tools for regional mitigation against tsunami impact and hence achieve enhanced resilience for a safer and more responsive society. The regional dimension is also imperative for the final consensus, distribution, and application of the hazard maps. To this end, the ongoing collaboration and the utilization of results from the ASTARTE project are vital elements. TSUMAPS-NEAM will transform the legacy of this (and others, e.g. STREST) research project into an assessment, to make it available at all levels of government methodologies through the cooperation of the scientific communities of a number of NEAM countries with the CTSPs, the IOC/UNESCO, and the CPAs. In addition, these results represent the primary input for potential future research activities, at European and National levels, for reducing uncertainty in PTHA.

## 11. Strategies for dissemination

The transnational character of tsunami hazard also makes the outcomes of TSUMAPS-NEAM of significant relevance not only for the EU member states but also for the Enlargement and Neighbourhood Policy countries. Applicability/transferability of the results to them is a main focus of TSUMAPS-NEAM, which will be maximized both toward general public and decision makers. A common platform will enable cooperation and communication of all relevant actors in tsunami hazard governance at all levels and across all sectors. The Publicity task serves for this purpose. End-users of the project (CTSPs and CPAs, UNESCO) are invited to play a double role; to present their needs to ensure that the deliverables are appropriate

for practical applications, and to bring these deliverables into immediate use (thus covering the last mile). Their dissemination will be achieved with maps, brochures, the web site, and web-based capacity building tools. The existing cooperation between DG-ECHO and ICG/NEAMTWS (e.g. in NEAMWAVE14 exercise) will be reinforced by integrating also North African countries that have not yet joined the activities at the required level. The technical approach, the number of partners involved, and the results of ongoing EU projects, hold a strong potential for dissemination. The partners already having key positions in UNESCO/ICG NEAMTWS and running CTSPs, which are linked with CPAs, will facilitate the project outcomes to reach the relevant stakeholders. A dissemination meeting with UNESCO member states will be organized back-to-back with ICG XIII. One capacity-building meeting will be instead organized in one Neighbourhood Policy country. Moreover, the importance of enhancing meaningful participation of young scientists, and all actors/professionals in the dissemination field will be considered in TSUMAPS-NEAM.

## 12. Sustainability

The main priority for ensuring long-term sustainability to TSUMAPS-NEAM is to maintain its web site with its user interface for querying the PTHA database, and consulting the documentation and guidelines. These products can be financially sustained by INGV, through its infrastructure dedicated to databases of scientific data connected with the European research network, included in its own strategic programmes, and in its agreement with the Italian CPA (INGV-DPC Framework Agreement 2012-2021). INGV also plays the role of CTSP in the framework of NEAMTWS. The responsible of the CTSP has clearly stated the intention of maintaining the database and the website for continued dissemination of the results (see enclosed letter). The project will create a technically sound user-interface by defining a standard database schema for hazard results, so that future updates (as new data and methods become available as results of future research) will not affect the technical realizations of the present project. Based on these preconditions also EPOS, a select ESFRI priority aimed at a long-term planning for a European Earth Science infrastructure, has expressed its strong interest and support. Moreover, several other well-established institutions have expressed their support to the project and its sustainability. They are the other CTSPs, IOC/UNESCO, and JRC. The partners will also promote this initiative within ICG/NEAMTWS. All these opportunities for future synergic efforts make TSUMAPS-NEAM a unique occasion for establishing a long term asset for tsunami hazard and risk mitigation policies in the NEAM region, and for public and institutional awareness raising and capacity building of the EU, along with the Enlargement and Neighbourhood Policy countries.

### List of Acronyms used in the T forms of TSUMAPS-NEAM proposal

**AGU** American Geophysical Union

**ASTARTE** Assessment, STrategy And Risk Reduction for Tsunamis in Europe EU FP7 project

**CARIBE-EWS** Coastal Hazards Warning System for the Caribbean and Adjacent Regions

**CAT** Centro Allerta Tsunami

**CI** Critical Infrastructures

**CPA** Civil Protection Agency

**CTSP** Candidate Tsunami Service Provider

**DG-ECHO** European Commission's Directorate-General Humanitarian Aid and Civil Protection

**DOI** Digital Object Identifier  
**DPC** Dipartimento Protezione Civile  
**EFEHR** European Facility for Earthquake Hazard and Risk  
**EGU** European Geosciences Union  
**EPOS** European Plate Observing System  
**ESFRI** European Strategy Forum on Research Infrastructures  
**ERCC** Emergency Response Coordination Centre  
**EU** European Union  
**GAR** Global Assessment Report on Disaster Risk Reduction  
**GEM** Global Earthquake Model  
**GPU** Graphics Processor Unit  
**HFA** Hyogo Framework of Action  
**HYSEA** Hyperbolic Systems and Efficient Algorithms  
**ICG** Intergovernmental Coordination Group  
**IOC** Intergovernmental Oceanographic Commission  
**IOTWS** Indian Ocean Tsunami Warning and Mitigation System  
**JRC** Joint Research Centre  
**JRC-IPSC** Joint Research Centre - Institute for the Protection and Security of the Citizen  
**KOERI** Kandilli Observatory and Earthquake Research Institute  
**MEDSUV** MEDiterranean SUPersite Volcanoes EU FP7 project  
**NEAM** North-Eastern Atlantic and Mediterranean  
**NEAMTWS** North-Eastern Atlantic and Mediterranean Tsunami Warning System  
**NEAMWAVE14** Tsunami Warning and Communication Exercise for the North-Eastern Atlantic, the Mediterranean, and Connected Seas Region  
**NGO** Non-Governmental Organization  
**NIOF** National Institute of Oceanography and fisheries  
**NOAA** National Oceanic and Atmospheric Administration  
**OB** Observers' Board  
**PDF** Probability Density Function  
**PMB** Project Management Board  
**PPRD SOUTH** Prevention, Preparedness and Response to natural and man-made Disasters  
**PTHA** Probabilistic Tsunami Hazard Assessment  
**PTWS** Pacific Tsunami Warning and mitigation System  
**REAKT** Real Time EArthquake RiSk ReducTion EU FP7 project  
**SC** Steering Committee  
**SFA** Sendai Framework for Action  
**SHARE** Seismic Hazard Harmonization in Europe EU FP7 project  
**SRB-RAS** Special Research Bureau of Russian Academy of Sciences  
**SSHAC** Senior Seismic Hazard Analysis Committee  
**STREST** Harmonized approach to stress tests for critical infrastructures against natural hazards EU FP7 project  
**TSUMAPS-NEAM** Probabilistic Tsunami Hazard Maps for the NEAM Region (this project proposal)  
**UNESCO** United Nations Educational, Scientific and Cultural Organization  
**UN-ISDR** United Nations International Strategy for Disaster Reduction  
**USA** United States of America  
**USGS** United States Geological Survey  
**VUELCO** Volcanic Unrest in Europe and Latin America EU FP7 project