The Global Tsunami Model (GTM) network

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GEM CONFERENCE – Are we making a difference?
13th - 14th June 2023
Centro Congressi Bergamo
Bergamo, Italy
Why GTM – background for the initiative:

✓ Multi-institutional work on hazard and risk for the UN-ISDR (Global Assessment Report, GAR)

✓ **Idea:** Need to gather scientific community for
  - *Collective effort for improved understanding of global tsunami hazard and risk*
  - Provide reference maps
  - Improve methods, develop guidelines and standards

✓ **Initiative from the tsunami community itself**

✓ Ensure relevance towards stakeholders
GTM’s added values and vision

The GTM overall vision and goals are to collaboratively achieve a thorough understanding of tsunami hazard and risk, together with the processes that drive them.

- Improve and Develop probabilistic tsunami hazard and risk analysis methods, tools and good practices
- Develop regional and global reference probabilistic tsunami hazard and risk models/maps
- Establish reference pools of experts
- Provide input and contribution to multi-hazard risk assessment through high-level harmonization with organizations covering other natural hazards
- Interact with stakeholders to ensure relevance and proper dissemination of results and
- Deal with uncertainty communication to non-scientists to contribute to risk management/reduction, inline with the SDFRR
Current GTM structure

✓ proposed to the tsunami community at IUGG June 2015, discussed among partners in several meetings since (AGU, EGU...)
✓ **Loose structure committing partners** to the GTM through signing of Letter of Interest (LoI’s)
✓ **36 Partners signed LoIs, more interested (involved in meetings etc)**
✓ INGV and NGI receive LoI’s on behalf of GTM and perform majority of secretary work
Global and European networking initiatives – chronology and interlinkage

✓ Global tsunami hazard and risk analysis for the UNDRR Global Assessment Reports (GAR). First probabilistic global risk analysis for GAR15.

✓ As a consequence the Global Tsunami Model (GTM) was formed as a networking initiative in 2015

✓ In 2016-2018: First European community based tsunami hazard map for Europe developed through the TSUMAPS-NEAM project

✓ In 2019 – the AGITHAR COST Action was funded for European partners, as an initiative to increase efforts to consolidate GTM

✓ The European tsunami community is a candidate Thematic Core Service (TCS) of the EC infrastructure EPOS-ERIC.

✓ A series of European projects aiming at providing community models contribute indirectly (ChEESE1&2, eFlows4HPC, DT-GEO, Geo-INQUIRE)
The project’s ecosystem
Hazard assessment workflow

**STEP 1**
Proportional earthquake model

- List of earthquake scenarios \( \{\sigma_t\} \)

**STEP 2**
Tsunami generation & modeling in deep water

- Parametrization of offshore all tsunami scenarios at all target POIs \((\max, T, H_0)\)

**STEP 3**
Shoaling and inundation

- Intensity distribution of inland tsunami intensity for all tsunami scenarios and at all target POIs, and relative epistemic uncertainty \( P(>\text{MIH}_{3%}, 50\,\text{yr}) | \sigma_t, POI) \)

**STEP 4**
Hazard aggregation & uncertainty quantification

- Hazard curves and maps for inland tsunami intensity at all target POIs, and relative epistemic uncertainty \( P(>\text{MIH}_{3%}, 50\,\text{yr}) | \sigma_t, POI) \)

TSUMAPS-NEAM Probabilistic Tsunami Hazard Maps for the NEAM Region

www.tsumaps-neam.eu

HPC supported by

- HySEA
- CINECA
Multiple-Expert Management Protocol

**Different groups**
(with different roles)

**Critical choices based on quantitative input**
(traceable but not controlled)

**Actors**
- Pool of Experts
- Project Manager + Technical Integrator + Evaluation Team
- Internal Reviewers

**Actions**
- Trimming of Alternatives
- Assignment of Weights
- Preliminary hazard model
- Pre assessment model
- Assessment model
- Dissemination of results

**Review**
- #1
- #2

**Participatory review**

TSUMAPS-NEAM
Probabilistic Tsunami Hazard Maps for the NEAM Region
www.tsumaps-neam.eu
GTM GLOBAL products

- GAR15 global tsunami risk maps
- Global tsunami hazard maps

Davies et al., GSL Special Publ. 2018
GTM regional products

- TSUMAPS-NEAM community hazard maps for Europe – Italy NEAMTWS
- Makran trench hazard analysis and community engagement

UNESCAP

Example alternative #1

Example alternative #2
ChEESE is the Centre of Excellence (CoE) for Exascale in Solid Earth and aims to become a hub for HPC software within the solid earth community.

Davies et al., GSL Special Publ. 2018

Murphy et al., 2016

Scala et al., 2016
CHEESE 2 GTM PTHA MODEL

Importance of slip heterogeneity

Romano et al., SREP, 2014
Romano et al., SREP, 2014

Satake et al., BSSA, 2013

Inundation distance

Shallow slip → Short wavelength → Small inundation distance

Deep slip → Long wavelength → Large inundation distance

TSUMAPS-NEAM Probabilistic Tsunami Hazard Maps for the NEAM Region
www.tsumaps-neam.eu
Community papers – dissemination - technological advances preparing for next steps – GTM - AGITHAR
Present operational status

✓ Presently GTM is a research network on hazard and risk modelling
✓ Mainly European focus / activity at present through networking, software provision, and guidelines for hazard and risk analysis:
  ✓ AGITHAR COST Action
  ✓ EPOS (European Plate Observing System) Tsunami Thematic Core Service (TCS) – service provision of hazard and risk tools through tsunamidata.org
✓ Significant technological progress of PTHA methods in European projects
Global Earthquake Model
Future Plans and Possible Collaborations

AGITHAR Stakeholders Workshop May 2023

Helen Crowley (Secretary General-elect)
Marco Pagani (Hazard Team Coordinator)
Vitor Silva (Risk Team Coordinator)

UCL, London, 17 May 2023
Ideas for GEM and GTM Collaboration

• Common modelling of global earthquake occurrence (defining and characterising seismic sources)
• Sharing global hazard products (e.g. stochastic event sets) as a common basis for global PSHA and PTHA
• Global exposure modelling
  • Increase spatial resolution of GEM’s global exposure model around coastal areas
  • Input on GEM Building Taxonomy for tsunami-related attributes (e.g. hydrodynamic attributes at the ground floor)
• Include tsunami hazard footprints, damage and loss data in Earthquake Scenarios Database
• Explore the use of OpenQuake-engine for tsunami risk assessment
• Prepare a project proposal on integrated assessment of risk accounting for both ground shaking and tsunami hazards.
Ideas for GEM and GTM Collaboration

- Common modelling of global earthquake occurrence (defining and characterising seismic sources)
- Sharing global hazard products (e.g. stochastic event sets) as a common basis for global PSHA and PTHA (ongoing collaboration: testing of EW PTF, AI surrogate models vs PTHA)
- Global exposure modelling
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- Explore the use of OpenQuake-engine for tsunami risk assessment
- Prepare a project proposal on integrated assessment of risk accounting for both ground shaking and tsunami hazards.
- Cascade effects: e.g. Tsunamigenic seismically-induced landslides?
Thank you for your attention!

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www.globaltsunamimodel.org