A Global Tsunami Model (GTM) network for increased understanding of tsunami hazard and risk

*Løvholt F[1], Harbitz CB[1], Griffin J[2], Davies G[2], Cummins P[2], Lorito S[3], Selva J[3], Basili R[3], Baptista MA[4], Babeyko A[5], Geist E[6], Parsons T[6], Thio HK[7], Leveque R[8], Power W[9], Burbidge D[9], Müeller C[9], Horspool N[9], Yalciner A[10], Kanoglu U[10], Suppasri A[11], Imamura F[11], Aguirre Ayerbe I[14], Gonzalez-Riancho[14], Gonzalez M[14], Wei Y[8,15], Titov V[15], von Hildebrandt-Andrade C[16], Macias J[17], Gonzalez-Vida JM[17], Gailler A[18], Necmioglu O[19], Lynett P[20], Paris R[21], Cardona O[22], Bernal G[23] et al**

[1]NGI, [2]Geoscience Australia, [3]INGV, [4]IPMA, [5]GFZ Potzdam, [6]USGS, [7]AECOM, [8]Univ Washington, [9]GNS, [10]METU, [11]IRIDES, [14]Univ Cantabria, [15]NOAA, [16]NOAA-CTWP, [17]Univ Malaga, [18]CEA, [19]KOERI, [20]USC, [21]CNRS, [22]INGENIAR, [23]CIMNE *+other organisations expressing interest*

Abstract: The 2004 Indian Ocean and 2011 Tohoku tsunamis highlighted the need for a thorough understanding of the risk posed by relatively infrequent but disastrous tsunamis. The latest Global Assessment Report (GAR15) resulted in fully global probabilistic tsunami hazard and risk maps, briefly presented here. Still, this complex assessment needs improvements based on the state-of-the-art research, e.g. in the treatment of uncertainty or inclusion of non-seismic tsunami sources, and in vulnerability and risk assessment. Towards implementing the Sendai Framework of Disaster Risk Reduction (SFDRR), further efforts are needed, requiring interdisciplinary expertise. We are therefore establishing a Global Tsunami Model (GTM) with the aim of i) a better understanding of tsunami hazard and risk analysis on a global scale and ii) providing a portfolio of validated tools for tsunami hazard and risk assessment at different scales.

GTM - towards integrating, standardizing, and harmonizing work on tsunami hazard and risk

What is GTM?

- A joint network of tsunami scientists working on probabilistic tsunami hazard and risk
- Proposed initiative from the tsunami community based on GAR – **(ToR in preparation)**
- Interested collaborators represents almost 30 organisations across the globe
- A preliminary webpage is under construction (http://www.globaltsunamimodel.org)

Why GTM?

- Contribute to the implementation of the *SFDRR* – in particular towards *Priority 1 – Understanding risk*
- Bring a new generation of global hazard and risk maps based on the previous GAR15 work (below)
- Understand the factors driving risk
- Promote standards and validated tools for tsunami hazard and risk assessment
- Capacity building to practitioners and stakeholders
- A broader involvement of the global tsunami community yields better understanding of tsunami risk

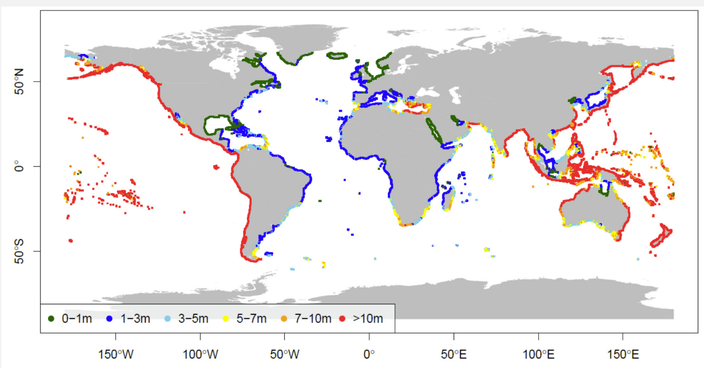
GTM General Objectives

- Harmonize efforts and products – GTM endorsement
- Develop standardized and open source tools, guidelines and practices
- Validate methods
- Provide results on global and regional scales to become a term of reference for local hazard and risk analysis
- Facilitate integration of results and tools from related organizations such as the Global Earthquake Model (GEM) and Global Volcano Model (GVM)
- Dissemination and geo-ethics

GTM preliminary Scientific Objectives (working group established – white paper in preparation)

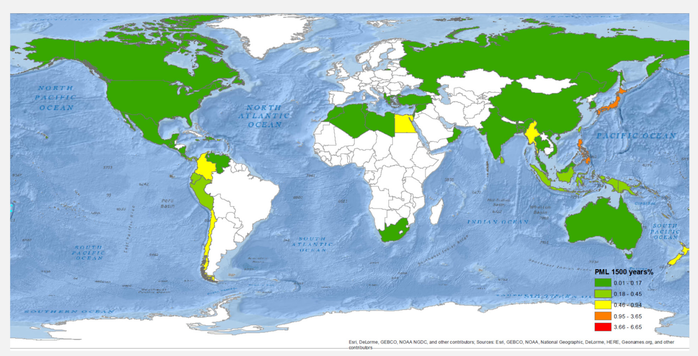
- Seismic sources: probability and modeling, both subduction zone and crustal earthquakes
- Non-Seismic sources: landslides and volcanoes, probability and modeling
- Tsunami modeling
- Development of methods and numerical tools
- Empirical and numerical Probabilistic Tsunami Hazard Assessment
- Vulnerability and fragility
- Probabilistic Tsunami Risk Assessment

Global tsunami hazard and risk analysis and mapping based on GAR15



Global tsunami hazard map (due to earthquakes) for a return period of 2500 years (Davies et al. submitted), showing the mean run-up values.

- **Methods: Probabilistic tsunami hazard and risk assessment (PTHA and PTRA)**
- **Sources:** Large earthquakes (magnitudes exceeding 7.8)
- **Hazard quantification:** Probability for the tsunami run-up height or flow depth to exceed a threshold value
- **Quantifying the tsunami risk as probability of losses:** Combining global exposure datasets, physical vulnerability curves and hazard maps
- **Large uncertainties related to**: Source recurrence, exposure and inundation, vulnerability etc. → **Hence global maps should be used with caution, and only for global and regional assessments**



Relative probable maximum loss, PML (loss/national exposed value) map for a return period of 1500 years (Løvholt et al. in press, INGENIAR and CIMNE, 2015). The largest PML's occur for small islands (not visible)

Main characteristics of the global tsunami hazard

- Dominated by earthquakes sources (about 80%). Other important sources are landslides and volcanoes.
- Although tsunamis propagate far – most damage (fatality and building damage) occurs near the source.
- The 50 most destructive historical tsunamis events caused 97% of all lives lost. In recent history, the 2004 Indian Ocean and 2011 Tohoku tsunamis dominate
- The infrequent tsunamis involving return periods of several hundreds to thousands of years dominate losses and challenge risk modelers
- The source (earthquake) statistics are poorly constrained at these return periods
- This makes the evaluation and communication of uncertainties as an important part of tsunami risk assessment

References

Løvholt F, Griffin J, and Salgado-Galvez M (in press), Tsunami hazard and risk assessment at a global scale, Encylopedia of Complexity and System Science, Springer

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