Coordinated efforts in tsunami hazard and risk analyses in Europe and the Global Tsunami Model network initiative

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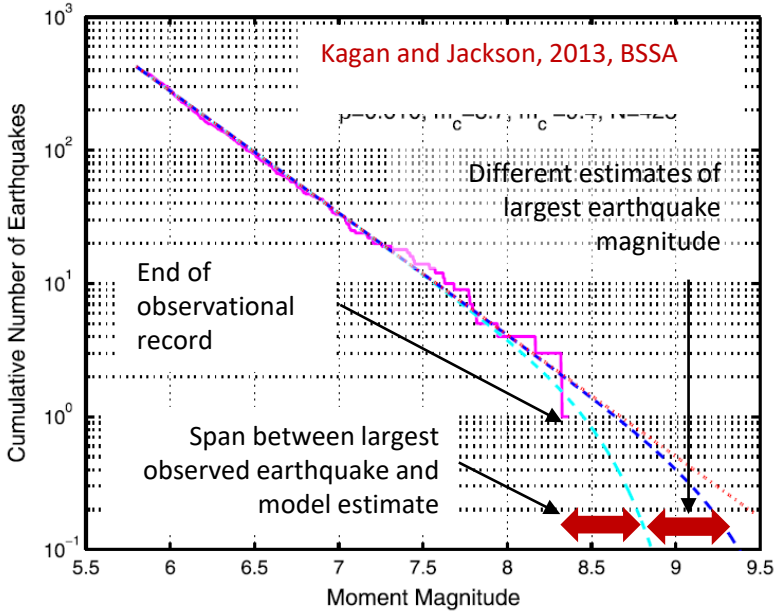
Infrequent tsunamis and uncertainty dominate losses and challenge risk modellers

- ✓ Global reach of tsunamis often render them transnational
- ✓ The tsunamis in 2004 and 2011 account for a majority of the monetary and mortality losses in the last 100 years
- ✓ Infrequent tsunamis dominate risk – return periods of hundreds to thousands of years
- ✓ The source statistics is poorly constrained at these return periods
  - Does not saturate at high return periods
  - Increasing uncertainty with higher return periods
- ✓ The understanding of the hazard from several tsunami sources are poorly understood, including
  - Tsunami earthquakes
  - Non-subduction earthquakes
  - Non-seismic sources (landslides and volcanoes)
- ✓ Standards non-existing, while consequences related to high return period tsunami hazards and their related uncertainties are formidable



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 presently pushing to provide a Thematic Core Service (TCS) of the EC infrastructure **EPOS** ERIC. If successful, this will provide a platform for community services and tools
- ✓All these initiatives are related to the common goals of better services and standards for tsunami risk analysis

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Why GTM?

- ✓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
  - Non-exclusive initiative ↔ open for the community
- ✓*Initiative from the tsunami community itself*
- ✓Ensure relevance towards stakeholders

GAR

Global Assessment Report on Disaster Risk Reduction

2015

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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.

- ✓Facilitate compatibility and improve ***probabilistic tsunami hazard and risk analysis methods*** through the development of ***standards, guidelines, methods, tools,*** and identification of key research questions
- ✓The development of regional and global ***reference probabilistic tsunami hazard and risk maps***, as well as ***standardized processes for developing local hazard and risk analyses***
- ✓Establish ***reference pools of experts*** for completing and reviewing tsunami hazard and risk assessments from stakeholders
- ✓The provision of a ***consistent input and contribution to multi-hazard risk assessment*** through high-level harmonization with organizations covering other natural hazards
- ✓The interaction with stakeholders to ensure relevance and proper dissemination of results and ***uncertainty communication to non-scientists***
- ✓To develop the above products while ***being mindful of their benefits for society***

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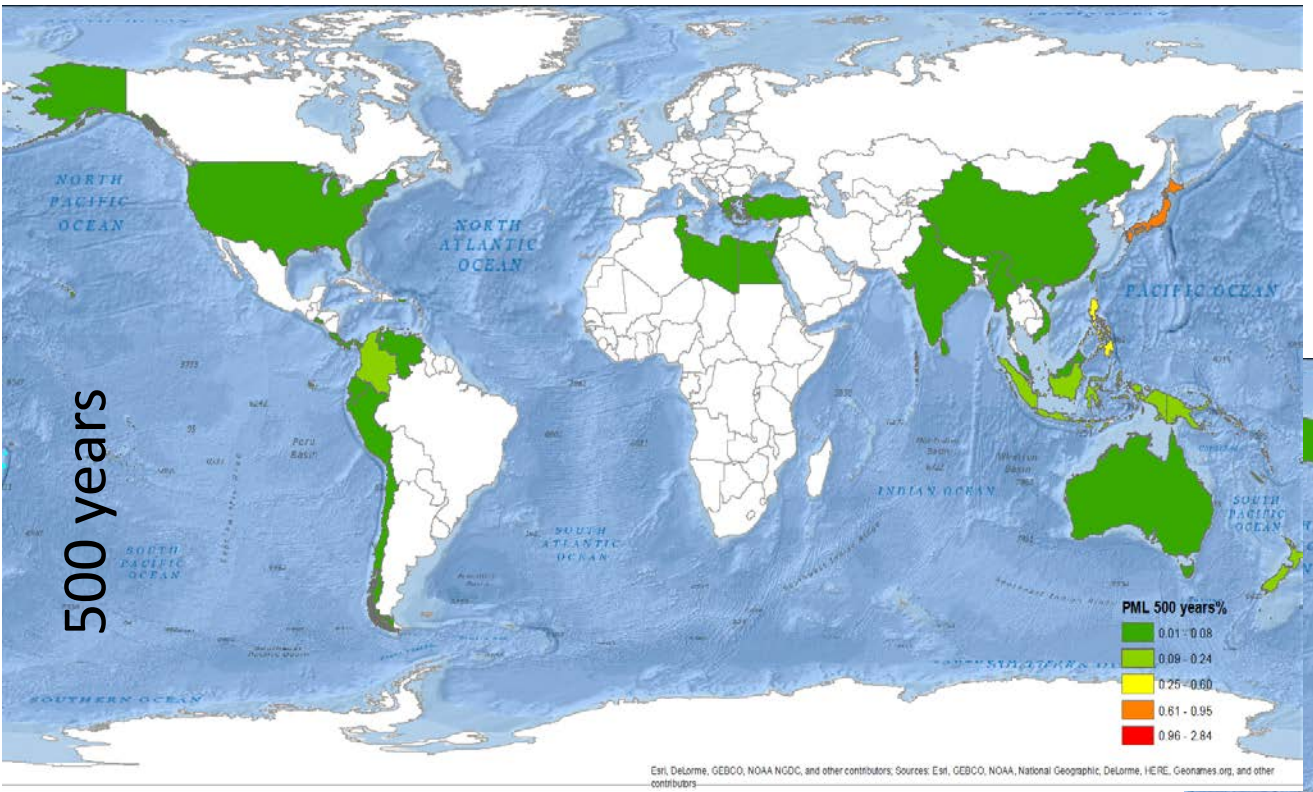
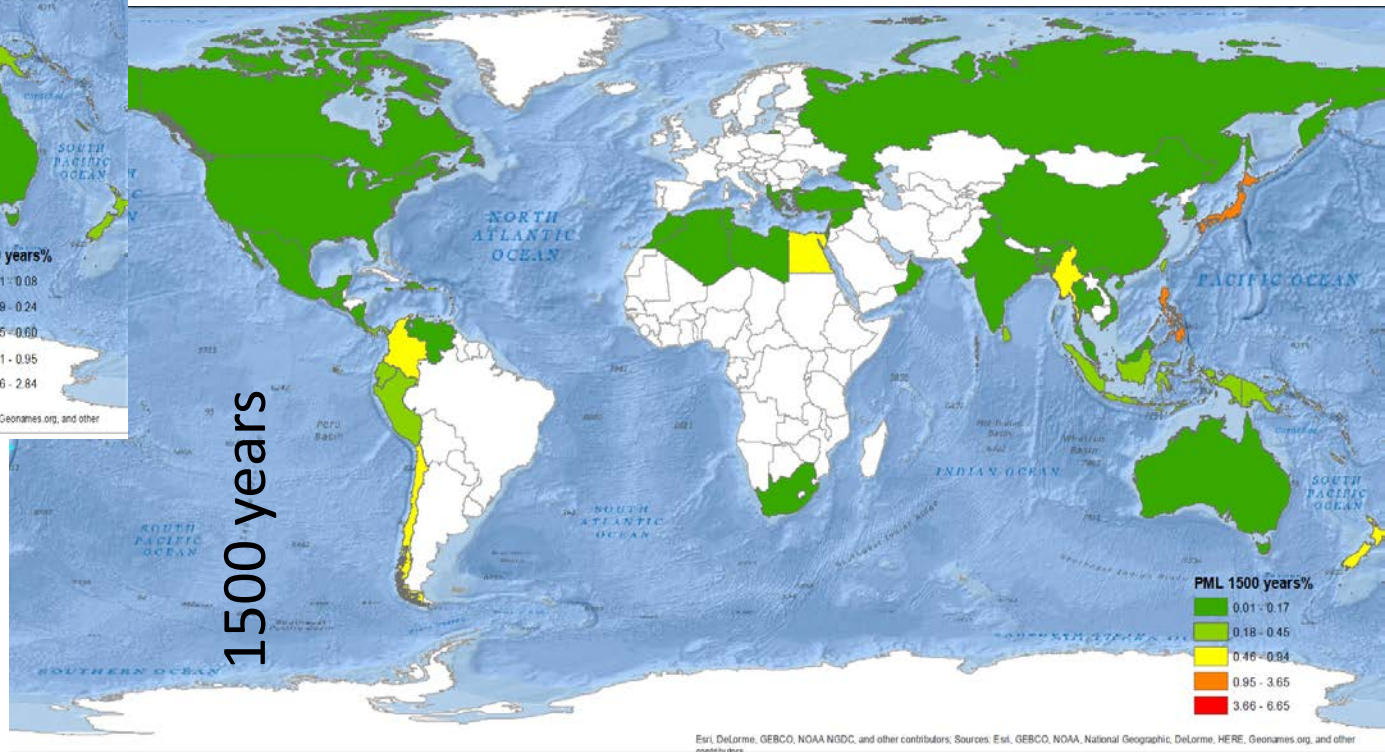
Global tsunami risk maps developed in GAR15

Probable maximum loss relative to total exposed value





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Common grounds and first GTM products

Related project results contributing to GTM:

✓GAR15 global tsunami risk maps

- Full tsunami risk analysis, but not disaggregation of hazard
- Focused on losses estimation for nations

✓TSUMAPS-NEAM

- Tsunami hazard maps for DG-ECHO (European Civil Protection)
- Makes use of GTM pool of experts: elicitation on critical, subjective choices (developing and weighting alternative models)

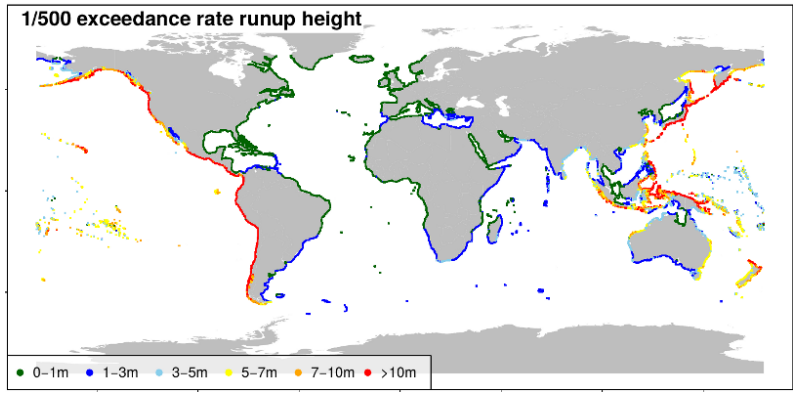
✓New global tsunami hazard assessment finalized

- Deeper analysis on earthquake model epistemic uncertainties

GAR

Global Assessment Report on Disaster Risk Reduction

2015



Davies et al., GSL Special Publ. 2017

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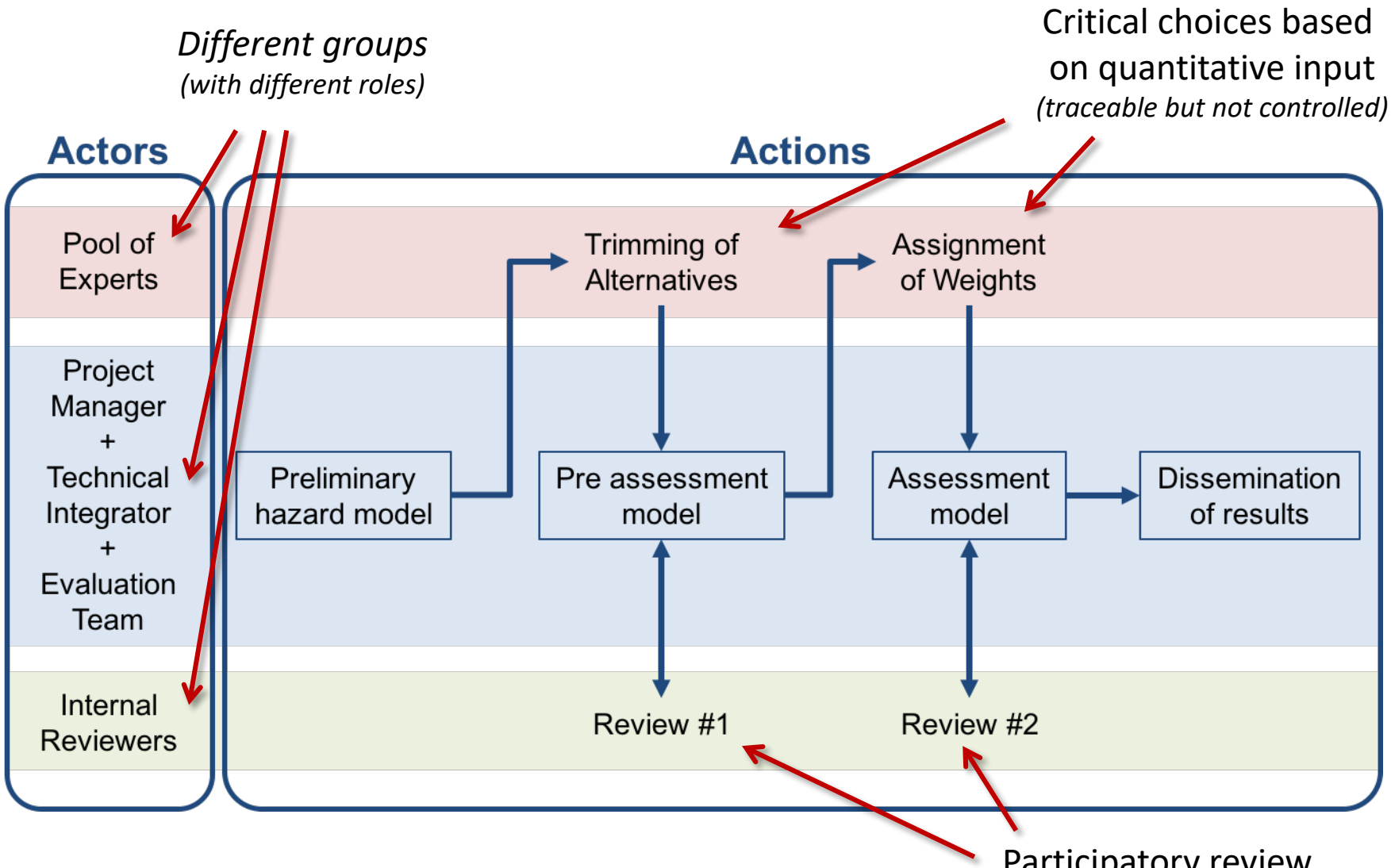
Common grounds and first GTM products

Pool of experts for TSUMAPS-NEAM for managing quantifying subjective probabilities / expert choices



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)
- ✓ **35 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

Relevant segments

- ✓Seismic source (probability and modeling)
  - Interface Global Earthquake Model (GEM)
- ✓Non-Seismic source (probability and modeling)
  - Interface with other global models covering sources such as Global Volcano Model (GVM)
- ✓Tsunami (probability and modelling)
- ✓Probabilistic Tsunami Hazard Assessment, PTHA
  - Non-earthquake sources
- ✓Vulnerability and fragility
- ✓Probabilistic Tsunami Risk Assessment
- ✓Development of standards and guidelines for tsunami hazard and risk quantification
- ✓Dissemination and geoethics (transparency – uncertainty communication)

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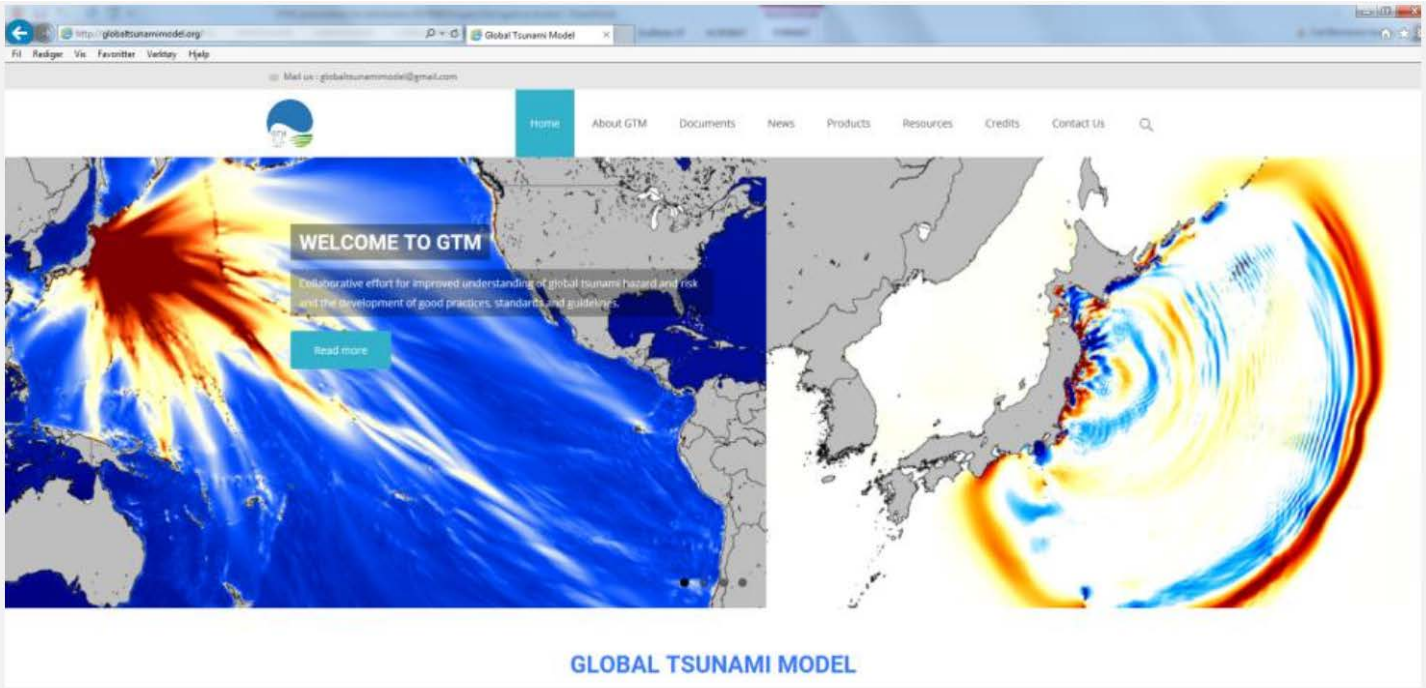
Priority items for GTM

- ✓General topics
  - Framework for uncertainty treatment
  - Develop standards and guidelines based on present good practices
  - Produce reviewed, well-documented, reproducible, and standardized global reference maps
  - Perform Hazard and Risk communication from the above products
- ✓Some specific scientific topics will be prioritized
  - Tsunami hazard from non-seismic sources
  - Submarine fault characterization
  - Homogenized global tsunami data handling

Interested in GTM?

globaltsunamimodel@gmail.com

http://www.globaltsunamimodel.org



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GFDRR Global Facility for Disaster Reduction and Recovery

UNISDR United Nations Office for Disaster Risk Reduction

AGITHAR - Accelerating Global science In Tsunami HAzard and Risk analysis

COST is supported by the EU Framework Programme Horizon 2020

A networking initiative to improve, standardize, and promote tsunami research. It uses specific COST tools - ***workshops, networking***, exchange of experts in order to

- ✓Assess current approaches in tsunami hazard and risk analysis, and evaluate them quantitatively by means of common metrics and benchmarks;
- ✓Determine gaps in order to achieve robust tsunami hazard and risk analysis
- ✓Across a variety of tsunami sources (earthquakes, landslides, volcanoes …)
- ✓Best practices and standards for probabilistic tsunami hazard and risk analysis, through discussion by a large group of practitioners;
- ✓Identify issues and challenges to orient future research
- ✓Disseminate the acquired knowledge among hazard and risk practitioners and end-users

AGITHAR main aims is to provide

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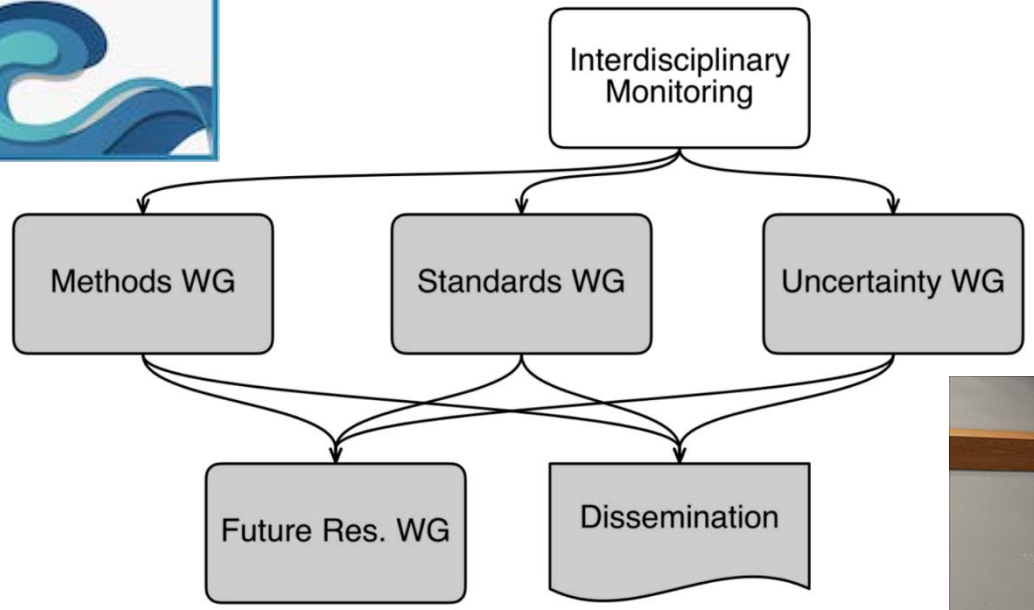
- ✓Inventory of Probabilistic Tsunami Hazard and Risk Analysis approaches (PTHA and PTRA)
- ✓Performance metrics and test cases (benchmarks) for individual components of PTHA and PTRA workflow
- ✓Structure for standardized PTHA and PTRA workflows
- ✓Quality assurance for PTHA and PTRA
- ✓Benchmarking for interdisciplinary quality assessment
- ✓Open Access data repositories
- ✓Implementation and dissemination of PTHA and PTRA methods to stakeholders and end users

AGITHAR Working Groups meetings



COST is supported by the EU Framework Programme Horizon 2020

Three meetings carried out so far

- ✓ Start up meeting Brussels March2019
- ✓ AGITHAR conference – October 2019
- ✓ Rome work meeting – January 2020

Panel discussion, WG Ideas Malta


Participants in Malta


Keynote speaker Gary Chock, ASCE


Participants in Rome

AGITHAR Deliverables and timeline

	#	month	description
2020	1	12	report on science gaps
	2	24	report on SPTHA
2021	3	24	repository for data, reports, etc.
	4	30	report on interdisciplinary challenges
	5	36	guidelines on stardardized PTHA
2022	6	36	guidelines on standardized PTRA
2023	7	48	report on future research directions

AGITHAR Structure

COST is supported by the EU Framework Programme Horizon 2020

- ✓Community effort
- ✓Open initiative for COST countries
- ✓26 member countries
- ✓~120 participants
- ✓Long term goal to provide building blocks for GTM
- ✓Link: https://www.agithar.uni-hamburg.de/
- ✓See also Jörn Behrens (AGITHAR chair) presentation in the COST Action session https://meetingorganizer.copernicus.org/EGU2020/EGU2020-5122.html

EPOS – ERIC European Plate Observing System

✓Established European Infrastructure

(https://www.epos-ip.org/epos-eric)

✓EPOS is a long-term plan to facilitate integrated use of data, data products, and facilities from distributed research infrastructures for solid Earth science in Europe

✓Organized among others through Thematic Core Services (TCS)

✓The tsunami community through initiatives such as AGITHAR and GTM has as one of its goals to propose a new TCS

Tsunami Research Activities / link to existing TCS's in EPOS

✓Tsunami research is highly multidisciplinary

- Source mechanism: seismology, geology, volcanology, landslides, GNSS-technology
- Sea-level measurements: tide gauges, cable technologies, satellite geodesy
- Numerical modelling including HPC-computing
- Hazard and Risk assessment and mapping

✓*TCS Tsunami* will be strongly connected to *TCS Seismology*, *TCS Volcano Observations*, *TCS GNSS Data and Products*, *TCS Near Fault Observatories*, *TCS Satellite Data*

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TCS Tsunami - examples of possible future contributions

- ✓Provide already existing services (data and tools) developed during joint projects (e.g., Probabilistic Tsunami Hazard Assessment Web-service)
- ✓Use EPOS platform for integration, consolidation and presentation of already existing data and tools in the form of EPOS services
- ✓EPOS as a testbed for new community joint research applications (e.g., probabilistic tsunami forecasting with uncertainty communication; global real-time tsunami impact forecasting etc)

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Conclusion

- ✓Global hazard assessment based on strong international collaboration
- ✓Strong networking component in tsunami community following such global assessments
- ✓The European community have strengthened through several networking and infrastructure initiatives
- ✓Future work aimed towards consolidating GTM through European projects and networking initiatives