United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

ICG/NEAMTWS 2030 Strategy of Pillar 1: Tsunami hazard and risk assessment

Audrey Gailler & Mauricio Gonzalez

Presently:

- Evaluation of the potential tsunami threat and quick response for appropriate action based **TWS decision matrices built on** the relationship between **first earthquake source parameters** and expected tsunami size.

Data required to improve the tsunami risk and hazard assessment:

- Tectonic setting (active seismic faults DB)
- Seismic catalogues
- Updated bathymetry in open seas
- Detailed topo-bathymetry at the coast
- Soil condition, land use
  - infrastructures, port facilities, industrial plants, tourists resorts, population distribution…
- Historical events for benchmarking

=> basis for decision support mechanisms to implement appropriate mitigation and preparedness measures to reduce the risk for coastal communities

EU projects including tsunami hazard assessment, vulnerability and risk:

- TRANSFER (2006-2009), ASTARTE (2013-2017), TSUMAP-NEAM (end 2018)

Four Strategic objectives for 2030

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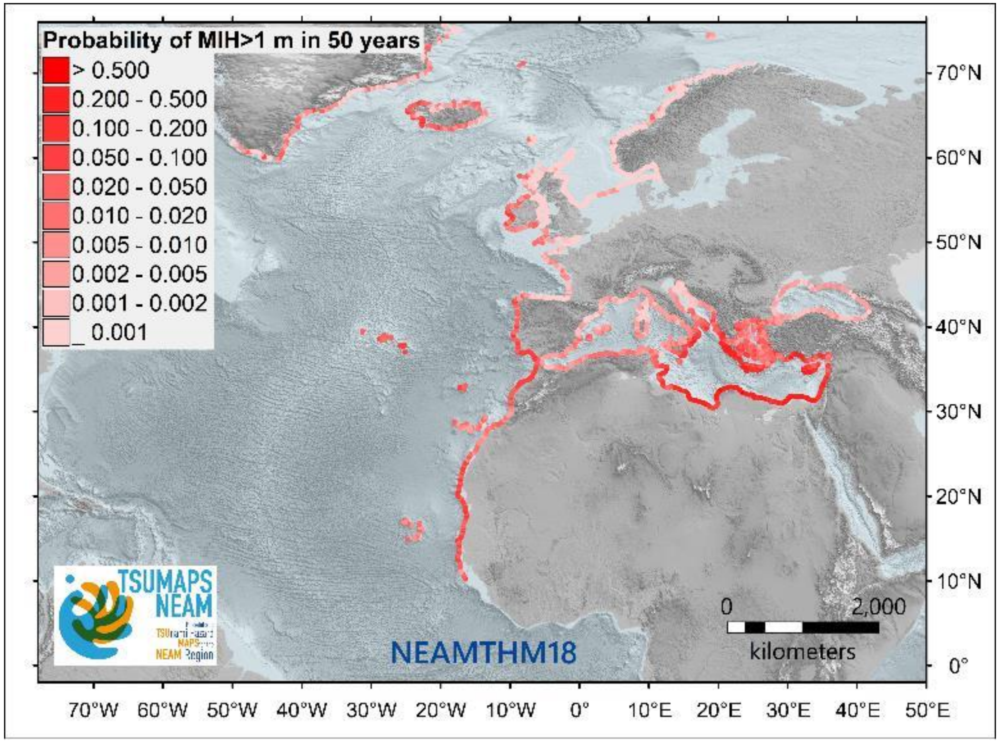
Objective 1: Implementation of probabilistic methodologies

- Regional PTHA as input for tsunami risk assessments and warning systems
  - Integration of all potential tsunami sources and effects
  - Complete hazard curves
  - Probability maps
  - Disaggregation of probability distributions to run any kind of possible scenarios
  - Basis for national PTHA efforts



The TSUMAP-NEAM model yields a picture of long-term PTHA of the NEAM region

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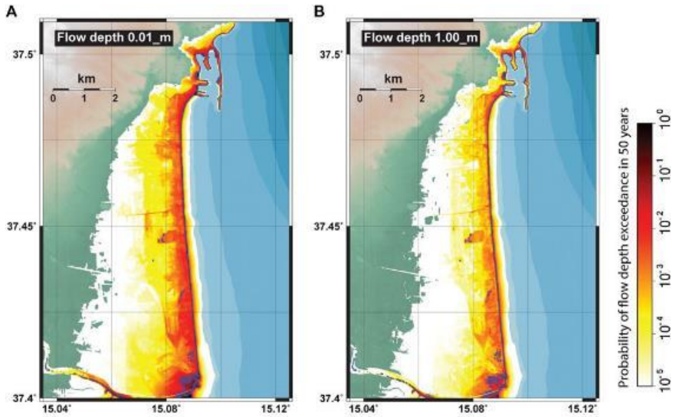
Objective 2: Member states to develop specific tsunami hazard/risk assessment for vulnerable national sub-regions

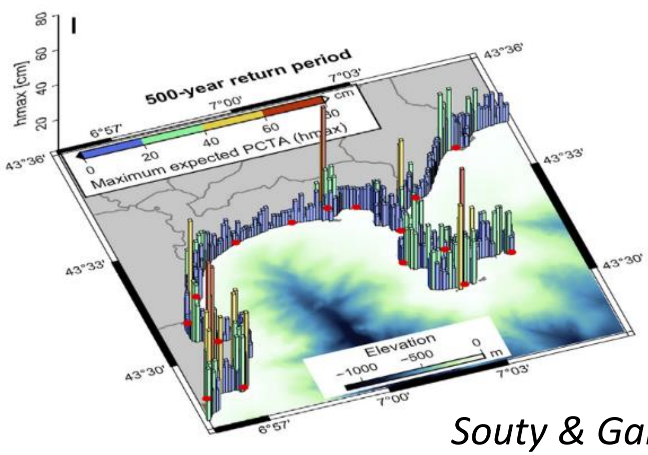
- Encourage **PTHA at a national level**

⇒ *improvement for risk assessment, long-term risk mitigation, evacuation plans,…*

- Work on a **common understanding of the best viable practices** in regional and national PTHA to comply with scientific and policy standards at a global level
  - State of the art on PTHA methodologies and application guidelines in countries
  - Need to **address how hazard should be propagated to risk**
  - Methodologies for probabilistic evacuation maps and criteria to define return periods
  - Create guidelines to elaborate TsunamiReady flooding maps & for local emergency plans.
  - Need to identify if/how models can help refining end-off/cancellation for SOP



Gibbons et al. (2020)



Souty & Gailler (2021)

☞ **Presentation S. Lorito 29/11 : From PTHA to planning and evacuation maps in Italy**

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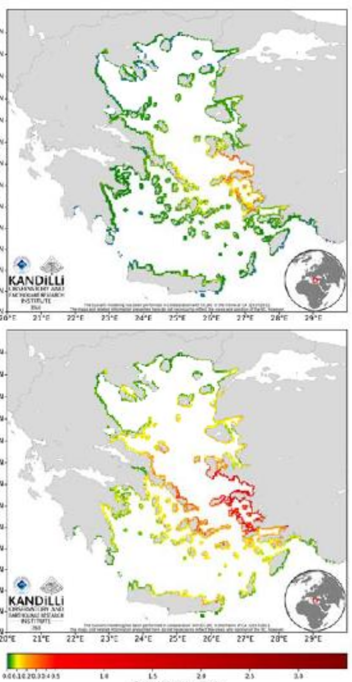
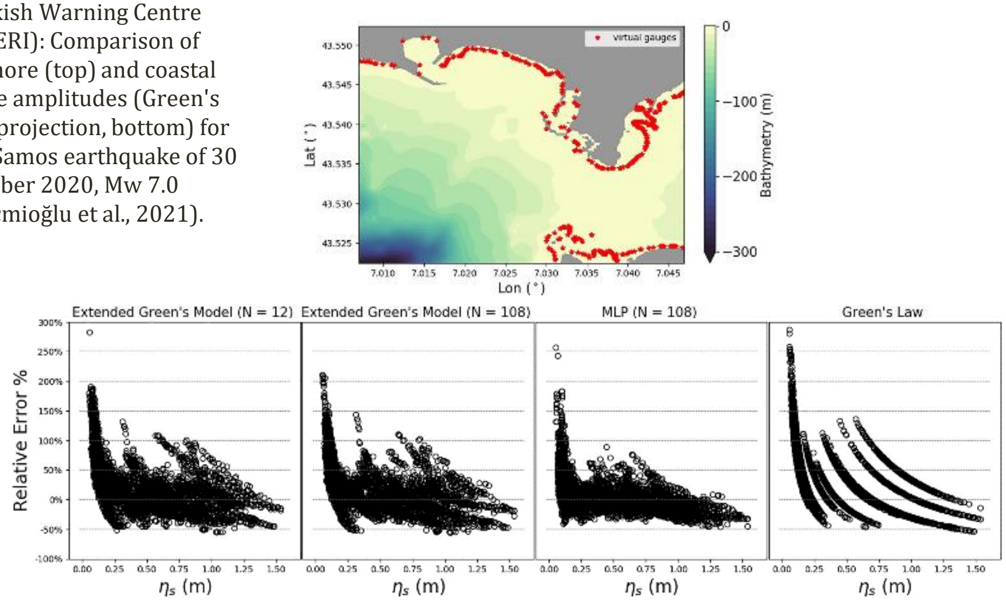
Objective 2: Member states to develop specific tsunami hazard/risk assessment for vulnerable national sub-regions

- **Pursue deterministic studies**
    - Amplification laws
    - Use of disaggregation techniques from PTHA models
    - HR coastal forecast from ML (including inundation estimate and land threat)
    - Benchmarking on historical and recent events

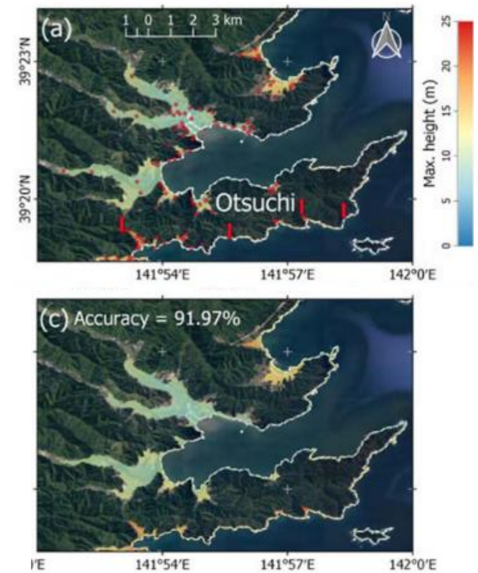
⇒ *valuable for identification of specific tsunami hazard and risk at a sub-regional level*



Coastal forecast map of the Turkish Warning Centre (KOERI): Comparison of offshore (top) and coastal wave amplitudes (Green's law projection, bottom) for the Samos earthquake of 30 October 2020, Mw 7.0 (Necmioğlu et al., 2021).



Comparison of several rapid forecasting methods in Cannes, France (Giles et al., 2022).



Simulated maximum flood heights at Otsuchi (Mulia et al., 2020). [a] Ref. numerical simulation. [c] DNN result (accuracies calculated with respect to [a]).

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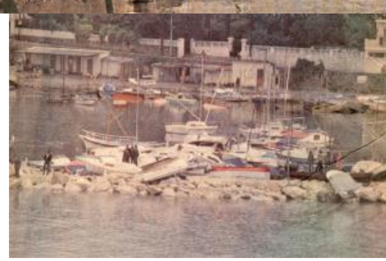
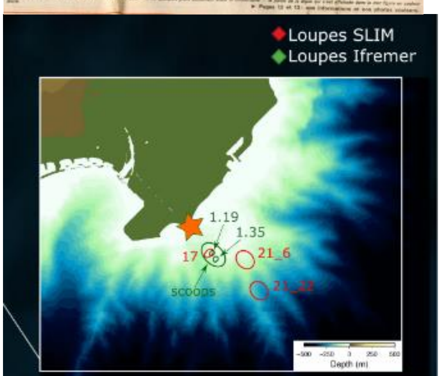
Objective 3: Develop regional hazard assessment for landslide-generated tsunamis

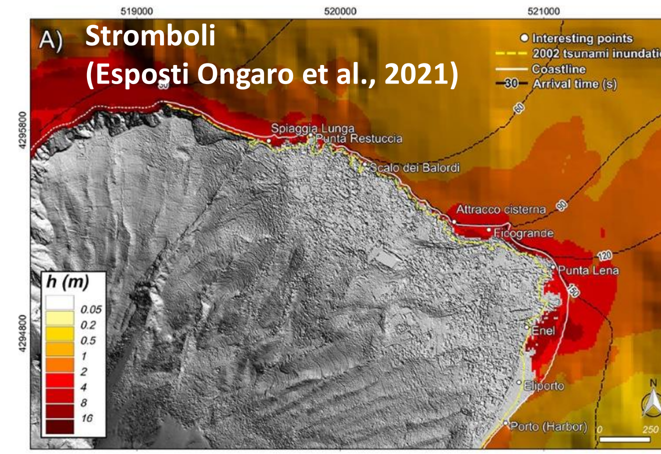
- Either submarine or sub-aerial => both can **produce local tsunamis in the NEAM area**
- **Deterministic approaches** (local, well identified targets)
  - Benchmarks to create
    - Stromboli, e.g. 2002 eruption (Esposti Ongaro et al., 2021)
    - Nice airport 1979, …?
- **Probabilistic approaches** (depending on the degree of knowledge of potential sources)
  - Nice airport, DT-GEO project

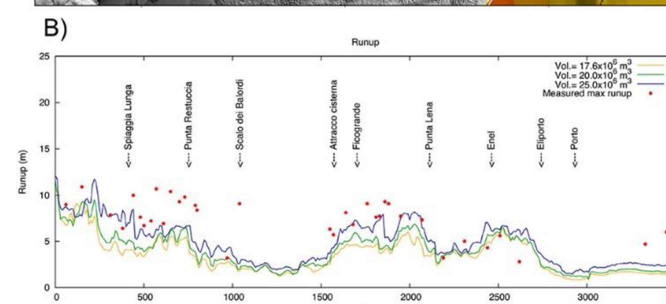




Nice 1979 event and airport slope most probale failures (Sultan et al., 2020)

☞ **Presentation M. Ripepe 29/11 : Stromboli TEWS**





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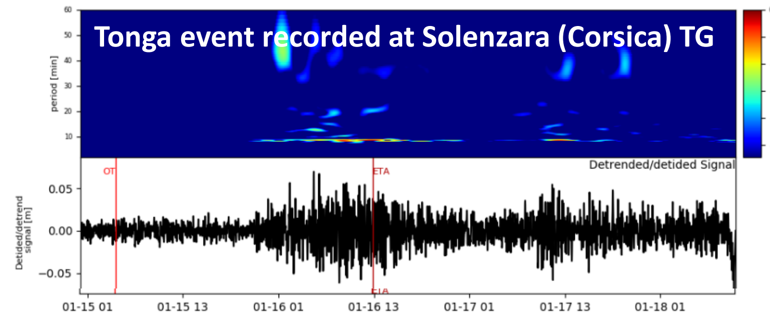
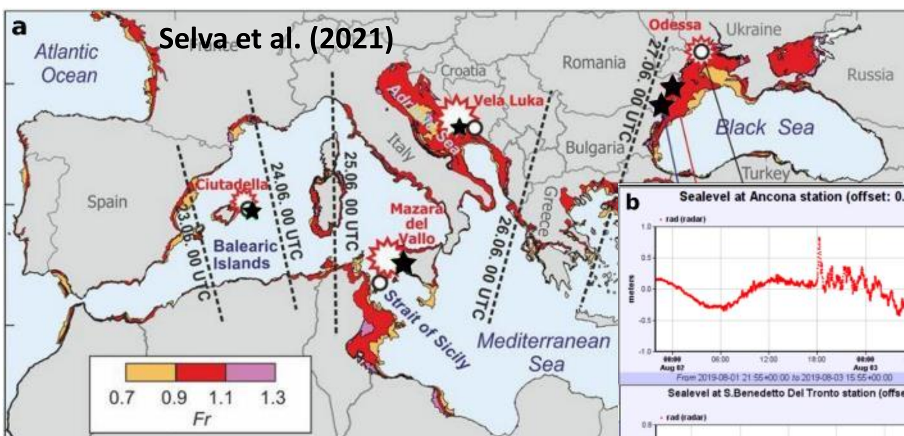
Objective 4: Multi-source tsunami hazard assessment

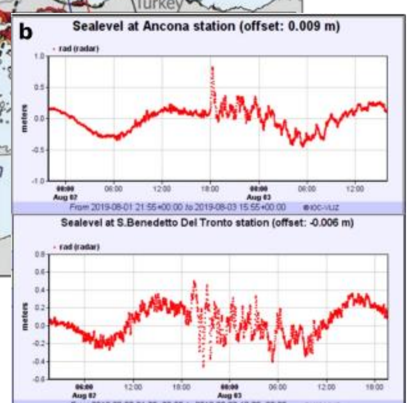
- Consider the different sources generating tsunamis, their relative intensities, probability of occurrence and uncertainties
  - Earthquakes
  - Landslides and volcanic activity
  - Meteo-tsunamis
  - Asteroid impacts

⇒ Should be facilitated by PTHA methods

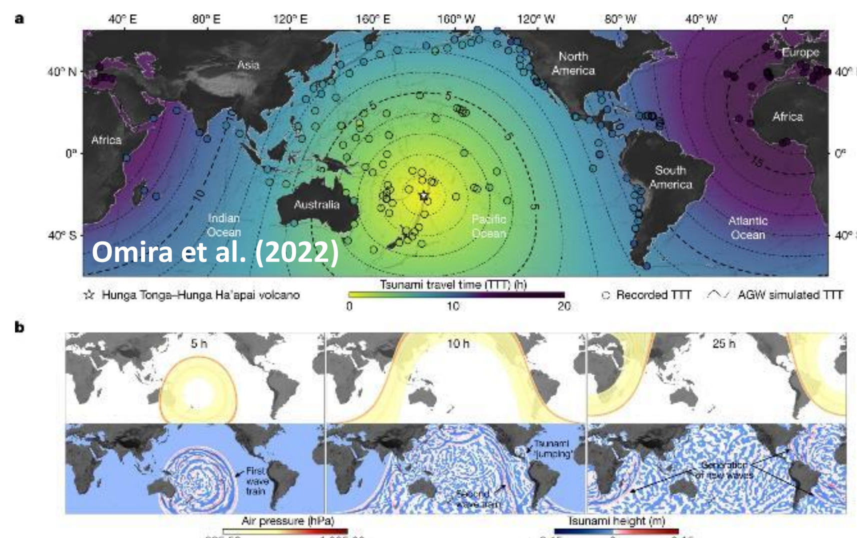
⇒ Estimate the probability of exceeding specific levels of tsunami intensity metrics (run-up,…) at POI, through hazard maps/curves







a Locations of meteotsunami events observed in the Med. and Black Seas during late June 2014 superimposed on meteotsunami-favourable coastal areas for which 0.9 < Fr < 1.1. **b** Tide-gauge signals of a meteotsunami recorded in the central Adriatic Sea in August 2019.



☞ **Presentation R. Omira 29/11 : The 2022 global Tonga tsunami**

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What can we learn from others?

(based on a review on tsunami monitoring, EW and hazard assessment in the Pacific ocean; Mori et al., 2022)

- Earthquake magnitude alone does not characterize the size and impact of the ensuing tsunami disaster
  - Need of constrain on coastal geomorphic features, densely populated area exposure
- PTHA and PTRA = Recently developed method of considering the variability of tsunami conditions for risk mitigation
  - Can be used in engineering design
  - Can be used to draw up tsunami inundation maps at different return period levels
    => to plan local and regional hazard mitigation
  - Methodologies and tools for Probabilistic hazard and Risk assessment in harbors
  - Probabilistic Evacuation maps and criteria to define Return period
- Mitigation of future tsunami risks goes through a better modeling reproduction of flow velocities and possible run-up in urban areas
- Long-term tsunami assessments to inform authorities about requirements for software (evaluation, assessment, planning) and hardware/structural (e.g., sea walls) countermeasures

Thank you for your attention