TSUNAMI HAZARD ASSESSMENT IN THE NEAM REGION

Prepare for the next tsunami

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Outline

1. Introduction

2. General tsunami information

3.Tsunamis in the North-East Atlantic, the Mediterranean and Connected Seas

4. Final Considerations

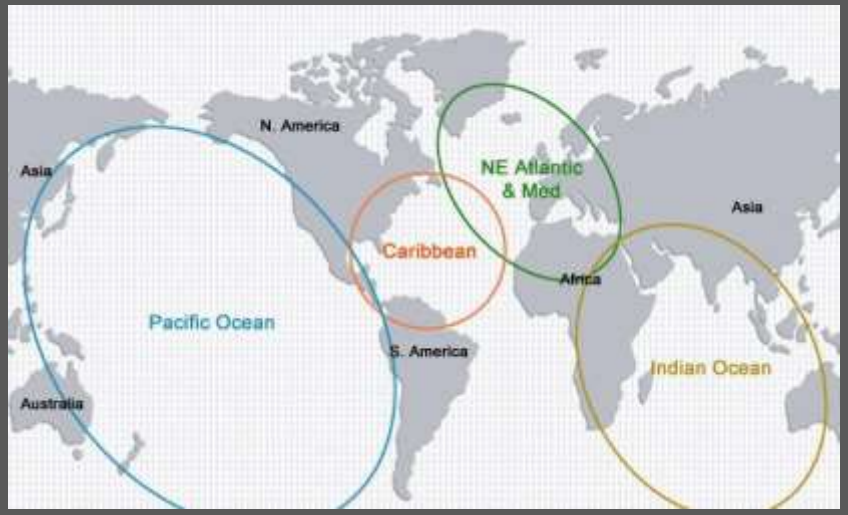
5. Challenges

26.12.2004 – Banda Aceh

11.03.2011- Tohoku area

Two massive tsunamis marked the beginning of the 21st century: the Boxing day tsunami in 2004 followed a magnitude 9.1 earthquake off the coast of northern Sumatra, Indonesia. This was the worst tsunami in recorded history; it claimed more than 200 000 lives along the shores of the Indian Ocean. Seven years later, Japan recorded a magnitude 9.0–9.1 earthquake off the coast of Tohoku. The tsunami killed over 15000 people, injured more than 6000 people, and more than 2000 are still missing

Following the 26 December 2004 tsunami in the Indian Ocean, the IOC Member States requested at the 23rd IOC Assembly (June 2005) that warning systems be developed in the Indian Ocean (IOTWS), the Caribbean (CARIBE-EWS) and the North-Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning and Mitigation System (NEAMTWS) similar to the Pacific Tsunami Warning System (PTWS).

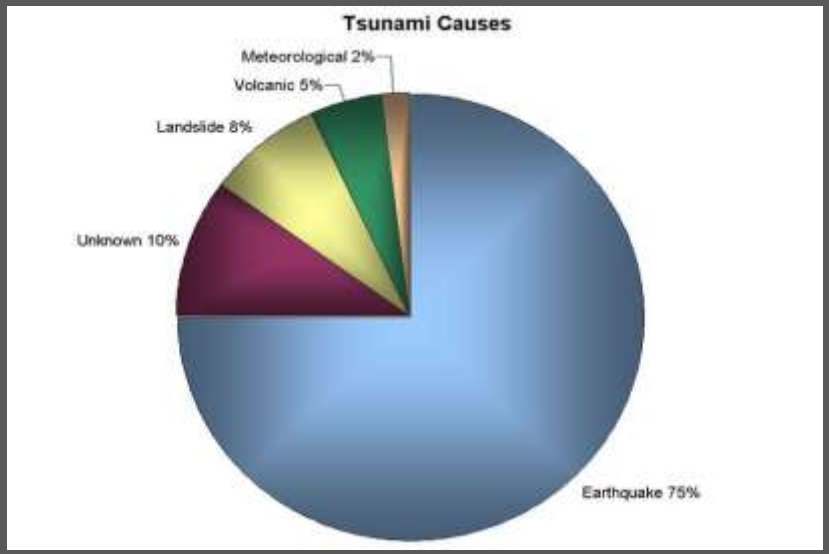


The Intergovernmental Coordination Group for the North-Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning and Mitigation System (ICG/NEAMTWS), formally established by the Intergovernmental Oceanographic Commission of UNESCO during the 23rd session of its Assembly in 2005 to coordinate the establishment of the tsunami Early Warning System and its activities. ICG/NEAMTWS is composed of 39 Member States[1] of both Mediterranean and North-eastern Atlantic regions.

What is tsunami hazard?

Tsunami hazard is the probability that a tsunami of a particular size will strike a particular section of the coast. (IOC, 2008)

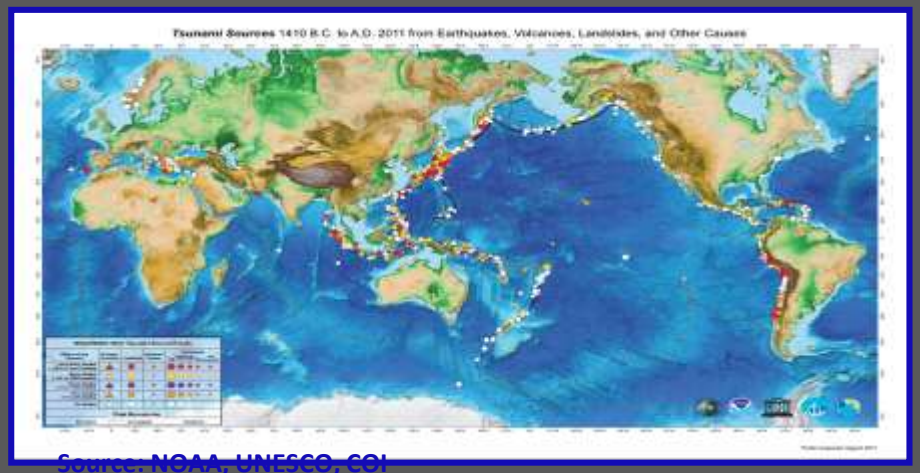
What causes tsunamis?



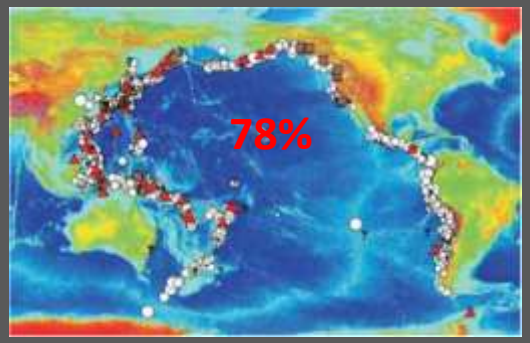
How often do tsunamis occur?

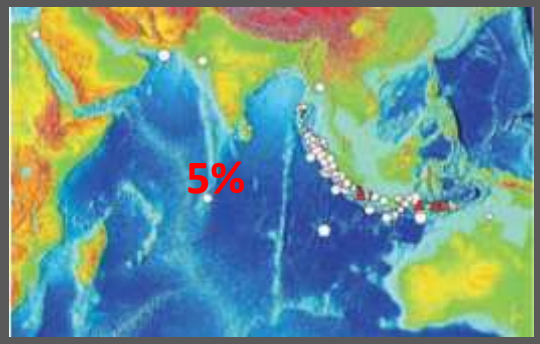
According to the Global Historical Tsunami Database, tsunamis that cause damage or deaths near their source occur approximately **twice per year.** Tsunamis that cause damage or deaths on distant shores (more than 1,000 kilometers, 620 miles, away) occur about **twice per decade.**

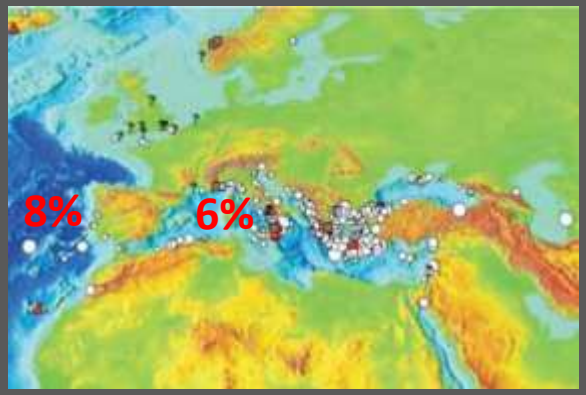
Where do tsunamis occur?

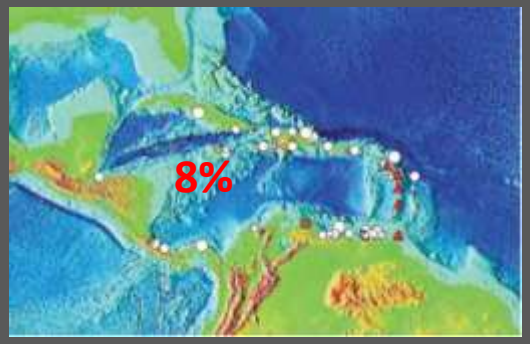


Source: NOAA, UNESCO, COI







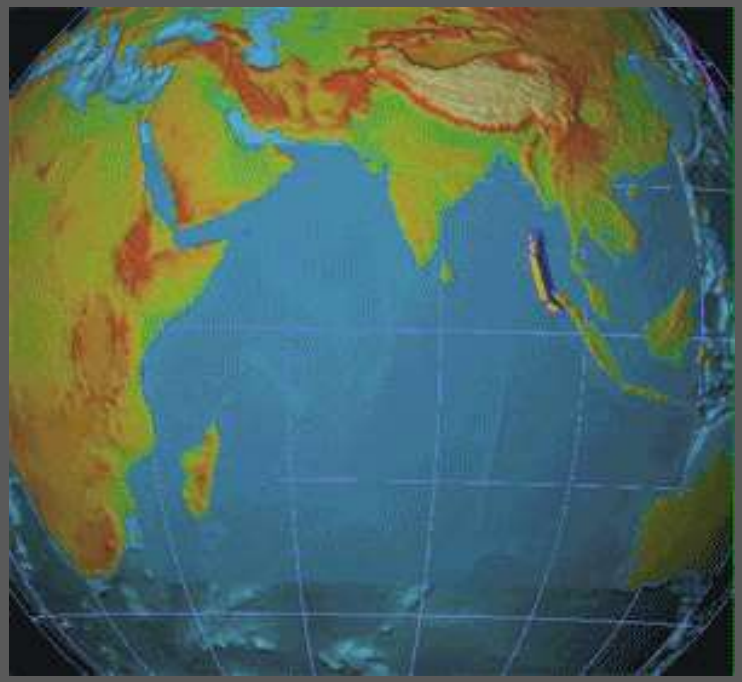


Tsunamis can be generated in all oceans, inland seas, and in any large body of water.
Between 1900 and 2015, about **78%** occurred in the Pacific Ocean (around the geologically active "Ring of Fire"), **8%** in the Atlantic Ocean and Caribbean Sea, **6%** in the Mediterranean Sea, **5%** in the Indian Ocean, and 1% in other seas. https://www.tsunami.gov/?page=tsunamiFAQ

2. General tsunami information

Most tsunamis are small and nondestructive or only affect coasts near their source, but some tsunamis can cause damage and deaths on distant shores (more than 1,000 kilometers, 620 miles, away).

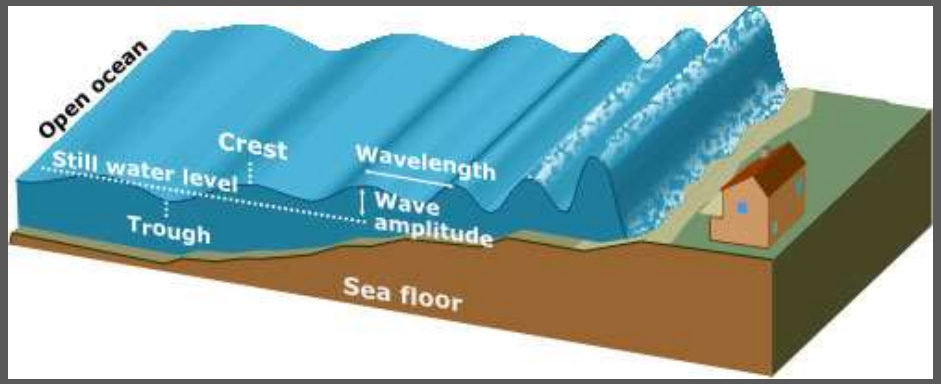
- **Local tsunamis** are tsunami s a nearby source for which its destructive effects are confined to coasts **less than 1 hour tsunami travel time**, or typically within about 200 km from its source
- **Regional tsunamis** are capable of destruction in a particular geographic region, generally within **1,000 km or 1-3 hours tsunami travel time from its source.**
- **Distant tsunamis – ocean wide- tele-tsunami** start as a local tsunami that causes extensive destruction near the source, continuing to travel across **an entire ocean basin** with sufficient energy to cause additional casualties and destruction on shores **more than a 1,000 kilometres from the source.**



http://upload.wikimedia.org/wikipedia/commons/4/47/2004_Indonesia_Tsunami_Complete.gif

What happens when tsunamis approach the shore?

In the open ocean, the tsunami waves propagate at fast speeds (hundreds of kms/hour).
When tsunamis reach the shallow water area, the speeds decrease, and their height grows near the coast.
Tsunamis can travel large distances with little energy loss.



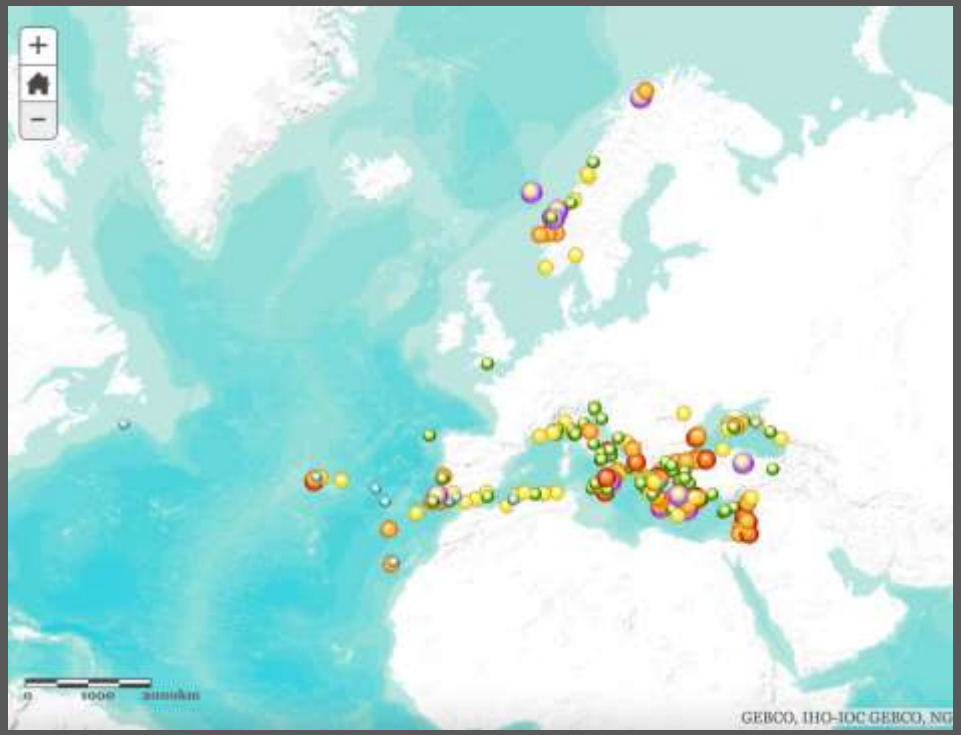
What happens when tsunamis encounters land?

The overland inundation is the most obvious hazard from a tsunami; tsunami waves advancing on dry land can snap trees, destroy engineered structures, and carry boats far in land; the behavior of the inland propagating of the tsunami depends critically on the topographic features of the area and the presence or not of engineered and natural obstacles;

The coasts of Europe, the North East Atlantic, Mediterranean and Connected Seas (NEAM region) are home to **all three types of tsunami sources**: earthquakes, volcanoes and mega-landslides.

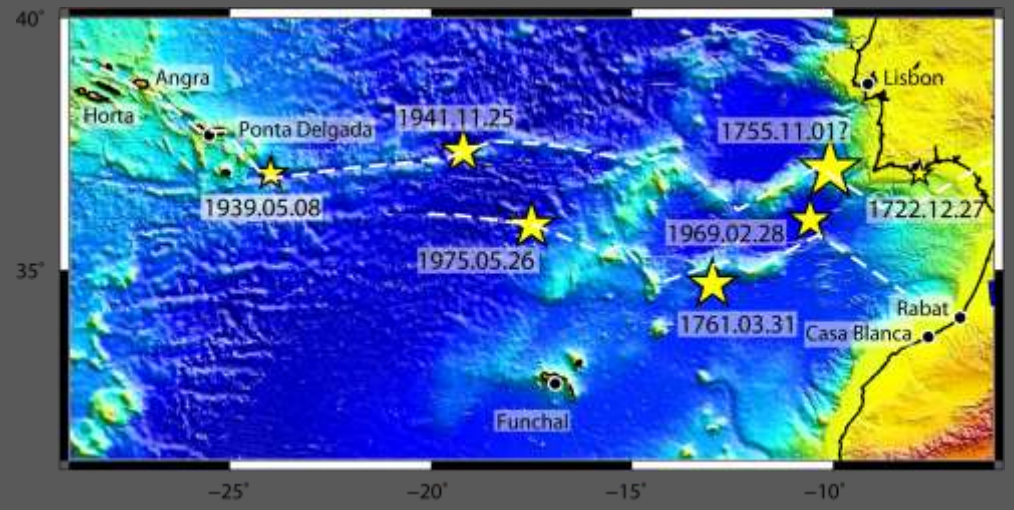
The **Mediterranean** hosted one of the deadliest tsunamis generated by the AD 365 Crete earthquake; Another major tsunami occurred in 1908 in Messina (Italy); Recently the 2002 Stromboli (Italy) and 2003 Boumerdés (Algeria) caused minor damage. However, this was not the case of the 2017 Kos-Bodrum or the 2020 Samos-Izmir events

The **North East Atlantic** was home of two (confirmed) ocean-wide tsunamis in 1755 and 1761. In the 20th century three earthquakes of magnitude greater than 7 occurred between Iberia and Azores (1941, 1969 and 1975)



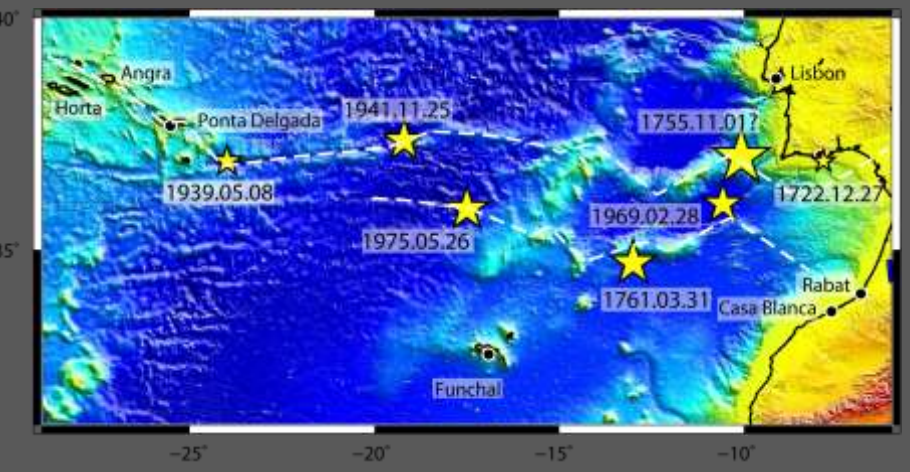
Maramai, et. al, (2014), The Euro-Mediterranean Tsunami Catalogue, ANNALS OF GEOPHYSICS, 57, 4, 2014

North East Atlantic events



The 1755 ocean-wide tsunami impacted the coats of Portugal (app 300km away from the estimated source) Spain and Morocco and travelled as distant as the UK and the Caribbean. The number of casualties is uncertain but estimated in 60000 deaths in Portugal due to the earthquake and the tsunami .

North East Atlantic events



- All these tsunamis occurred **outside summer-season**;
- The 1969 event reached the coast in **low tide condition**

25.11.1941

6 pm 25 November, an 8.3 earthquake 800 km away from Portugal mainland; tsunami recorded in the UK, Morocco, Azores and Madeira; the local press reports that the sea flooded beaches and streets in Oporto, and that the ships anchored, in Lisbon,were observed to crash against each other

28.02.1969

2 am 28 February a magnitude 8.0 earthquake occurred 350 km away from Portugal mainland; the tsunami was recorded in the, Morocco, Azores and Madeira ,Canary islands, and Newlyn (UK.). The shortest tsunami travel time to shore was 32 minutes; The Moroccan press referred a small "Raz de marée" in Rabat and Casablanca. At Rabat, the sea rose 80 cm

26.05.1975

9 am, 26 May magnitude 7.90 earthquake 800 km away from Portugal mainland; tsunami recorded in the, Morocco, Azores and Madeira ; Canary islands7.9

Local press reports: At 9:40 am at the artificial harbor and at the “old sardine pier “was observed the fast withdraw of the sea and returning back reaching high tide mark; some boats touched the bottom.

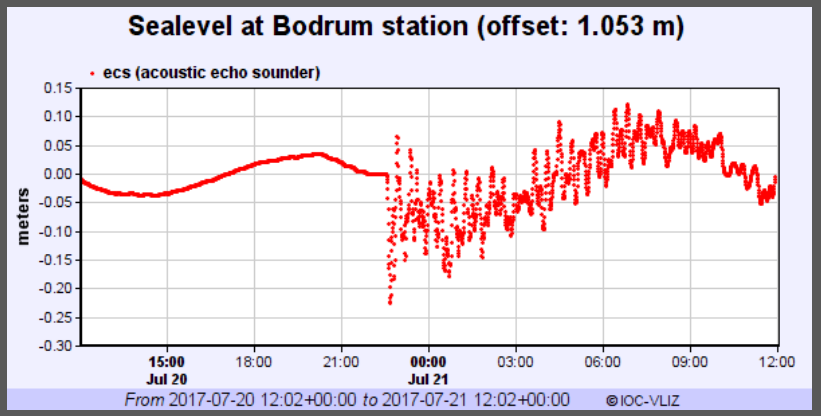
Recent events in the Mediterranean Sea

Earthquake in Turkey and Greece leaves at least two dead in Kos

6.5-magnitude quake between Bodrum and Greek islands strikes at start of peak holiday season, injuring more than 200 people

Turkey and Greece hit by strong earthquake - latest

Harbor damage in Turkey, July 2017
Courtesy of Prof A. Yalciner



Recent events in the Mediterranean Sea

On 30 October 2020, a significant tsunami triggered by an earthquake of magnitude 7.0 Mw hit the island of Samos (Greece) and the Aegean coast of the Izmir region (Turkey). The event shed light – once again – on the complexity of warning of locally generated tsunamis of rapid onset which challenged the ability of local authorities and communities at risk to take early action. According to the Turkey's Disaster and Emergency Management Authority (AFAD), one of the confirmed victims in Turkey drowned because of the tsunami.

This event is a bitter reminder after the wake-up call on 20 July 2017, following the Bodrum (Turkey)-Kos (Greece) tsunami, to increase tsunami preparedness through enhanced sea-level detection networks, education, as well as international cooperation

https://en.unesco.org/news/serious-tsunami-hits-greece-and-turkey-after-70-earthquake

this is a BBC video to see it go to:
https://www.bbc.com/news/av/world-europe-54757016to

Is the citizen aware about the risks in Europe?

The highly populated shoreline with the continuous growth of tourism and economic activity increases the potential losses caused by tsunamis. Tsunami waves can reach the shore minutes after an earthquake, a volcanic eruption or a submarine-landslide.

Recent surveys show that local citizens and occasional tourists reveal a low level of tsunami awareness and do not recognize the natural signs of an approaching tsunami

What should a tsunami early warning be able to provide?

- detect an on-going tsunami event,
- compute robust estimates of time of arrival and potential impact
- provide decision makers and citizens with timely alerts

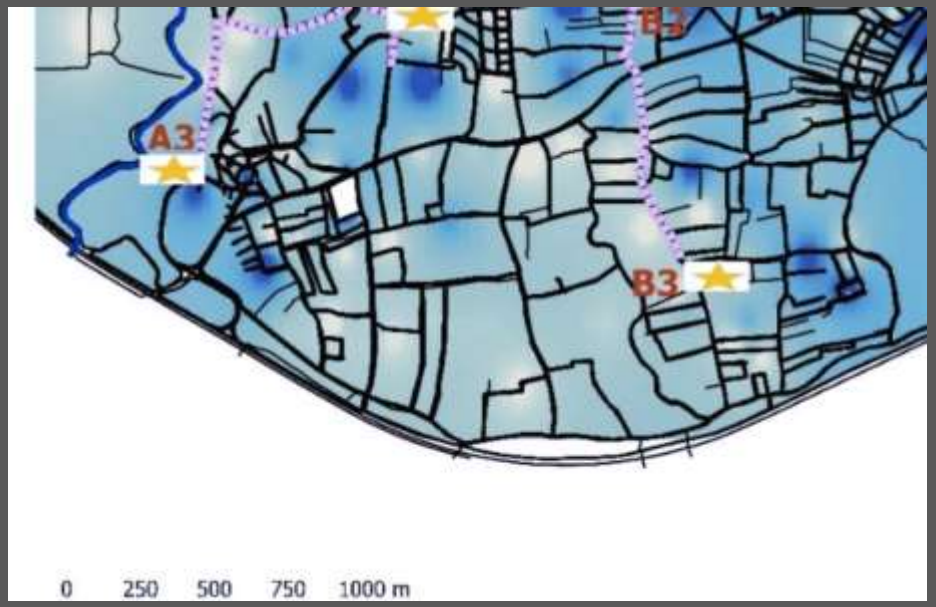
The Northeast Atlantic and the Mediterranean has now five TSPs tsunami Service providers that can issue warning messages in case of an event.

Nevertheless, the system will gain from the deployment and operation of cabled seafloor sensors, able to provide on-time and accurate information.

These sensors would contribute to shorten the latency between the earthquake detection and the tsunami warning!

What do we need to improve?

- lack of official evacuation sites for tsunami hazards
- discrepancies between official earthquake safety zones and safe areas for tsunamis
- lack of evacuation routes between low-lying beaches and higher areas;
- poor awareness of the existence of warning systems.



Fastest evacuation routes in the area of Gazi, western segment of Heraklion Greece test-site. (ASTARTE FP7 project), NOA contribution

5. Challenges

- Early Warning Systems will perform well only if people at risk knows what to do!
- How to use hazard maps and communicate uncertainties to general public and coastal managers?
- How to prepare populations that never felt an event? There is an urgent need to involve authorities & populations

Tsunamis are natural hazards!
We can not prevent them, but we can mitigate their impact!

Thank you!