

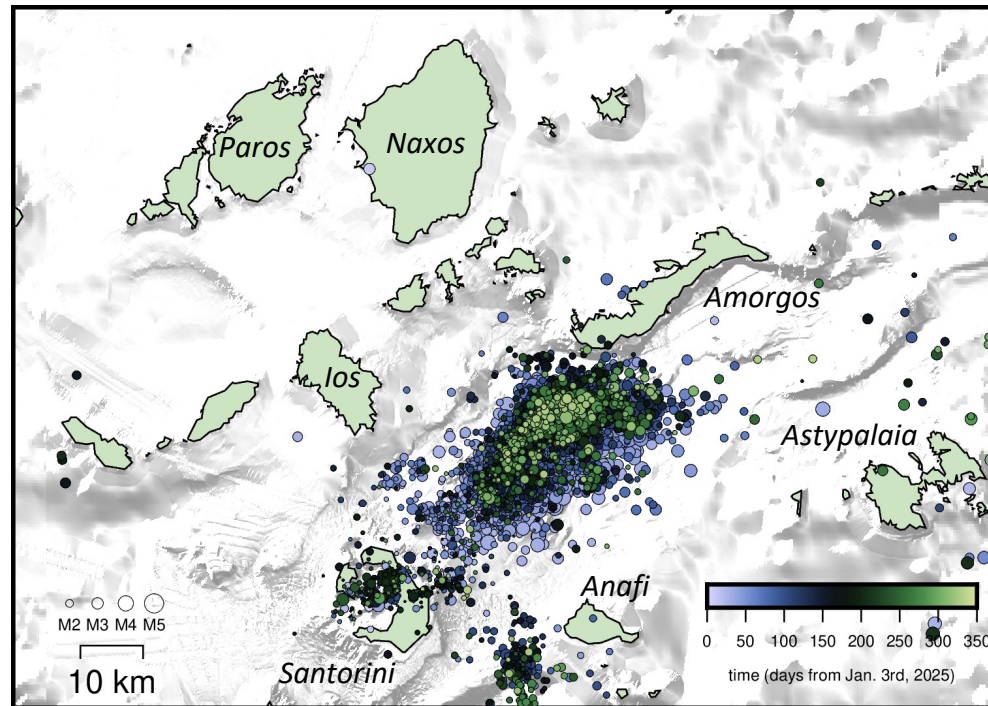


Tsunami Service Provider

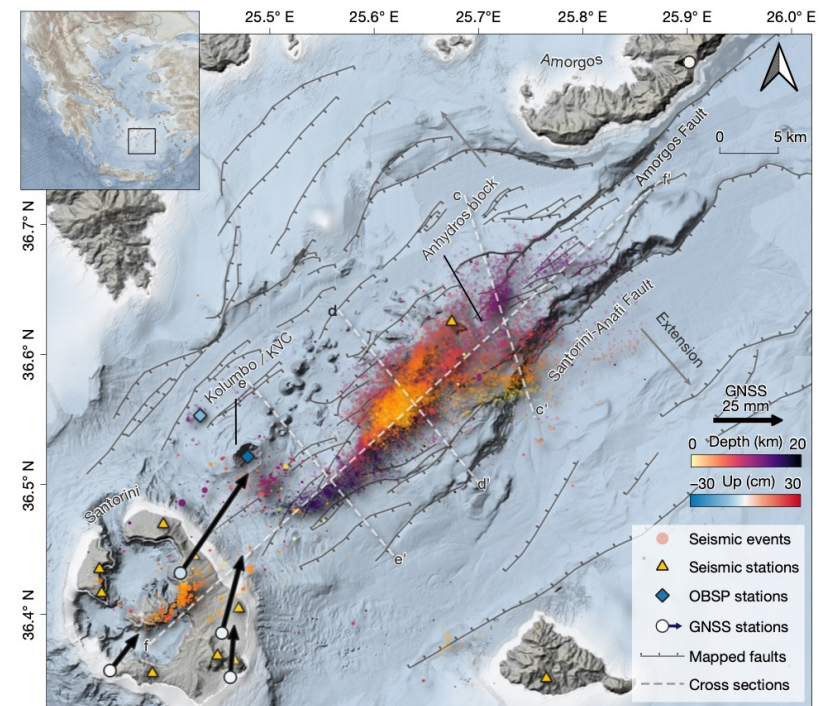
Hellenic National Tsunami Warning Centre

**Institute of Geodynamics
National Observatory Athens**

The 2025 Santorini volcano-tectonic crisis



The NOA earthquake catalogue (gein.noa.gr) includes over 9400 events for this area since January 3rd, 2025, with three events of $M > 5$.



The high-resolution ML earthquake catalogue includes more than 30,000 event between October 1st 2024 and February 2025; Isken et al., *Nature*, 2025.

The 2025 Santorini volcano-tectonic crisis

HL-NTWC response to the crisis:

- Close monitoring of the seismic activity in the Santorini–Amorgos area with heightened readiness for the possible issuance of tsunami warning messages (TWMs), in accordance with SOPs.
- Three TWMs (information-level) issued in February 2025 for earthquakes in the area.
- Installation of two temporary tide gauges, in Santorini and Amorgos, to monitor sea level changes – one has already been replaced with permanent station and the other will soon be replaced.
- Briefing of national CPA on tsunami risk due to increased seismic activity in the area.
- Participation of HL-NTWC officers in national *Subcommittee on Terrestrial/Marine Geology* advising the national *Permanent Scientific Committee for Monitoring the Hellenic Volcanic Arc* regarding issues related to tsunami hazard, warning and mitigation.
- Collaboration with academic institutions and CAT—INGV on (deterministic and probabilistic) seismic tsunami hazard assessment in the region.

PTF in the Santorini-Amorgos area

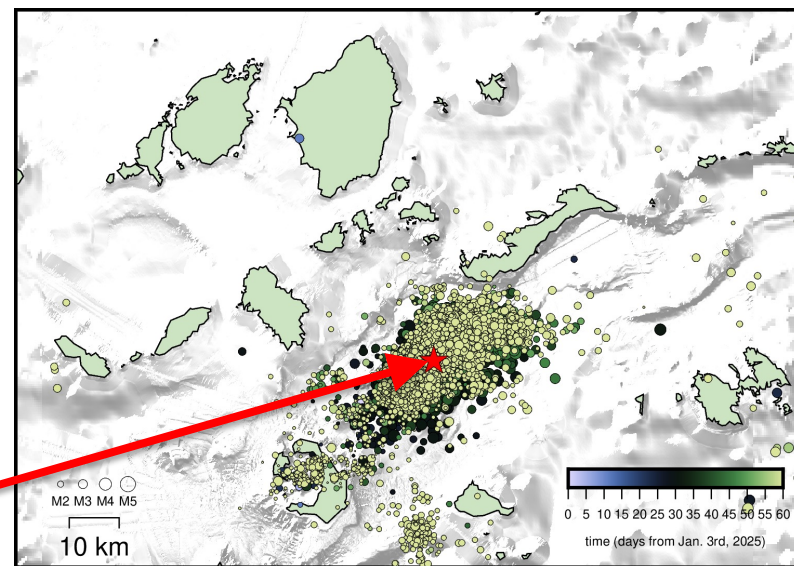
Application of Probabilistic Tsunami Forecasting (PTF)

Problem statement from a decision-maker perspective:

- What would the tsunami impact be if a magnitude X earthquake were to occur in the Santorini-Amorgos area where the seismic swarm developed?

Scientific approach to the problem:

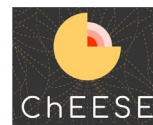
- Employ the Probabilistic Tsunami Forecasting methodology (PTF; Selva et al., 2021) and high-resolution inundation simulations to assess tsunami hazard in selected locations.
- An application example is provided for a hypothetical earthquake location in the middle of the seismic swarm epicenters, for magnitudes 7.0, 7.3 and 7.5.



with contributions by at least:



DT-GEO



EPOS
EUROPEAN PLATON OBSERVING SYSTEM



CENTRO
ALLERTA

TSUNAMI

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA



Hellenic National Tsunami Warning Center
Institute of Geodynamics, National Observatory of Athens



PTF in the Santorini-Amorgos area

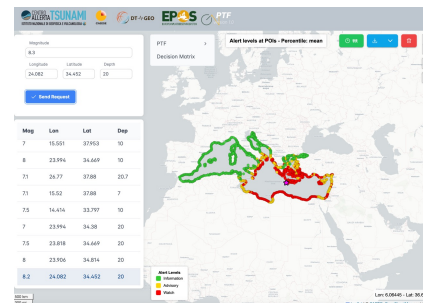
How Probabilistic Tsunami Forecasting (PTF) is done—Tsunami propagation and impact

PRE-CALCULATED SCENARIOS EARLY WARNING VERSION

It works in near-real time at the CAT-INGV Tsunami Warning Centre (<https://www.ingv.it/cat/en/>), which is a NEAMTWS Tsunami Service Provider (<http://www.ioc-tsunami.org/>).

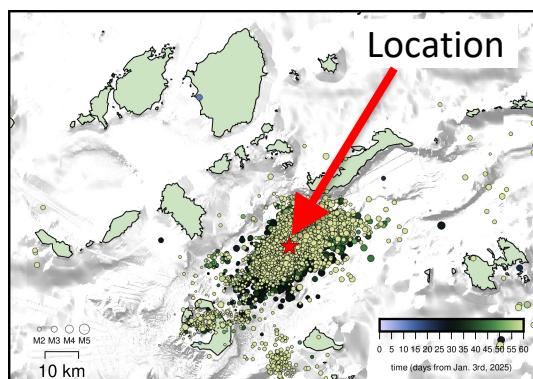
It is in the Calibration/Validation towards the fully Operational deployment at the CAT-INGV Tsunami Warning Centre.

Targeting seconds to tens of seconds execution time
w/ pre-calculated scenarios



EXAMPLE for Santorini-Amorgos area

PTF



Magnitudes:

- 7.0,
- 7.3,
- 7.5.

Depth:

- fixed to 10 m

NEAMTWS Decision Matrix

Depth	M	Epicenter Location	Tsunami Potential	ALERT LEVEL VS DISTANCE		
				$\Delta eq \leq 100$ km	$100 \text{ km} < \Delta eq \leq 400$ km	$\Delta eq > 400$ km
< 100 km	$5.5 \leq M \leq 6.0$	Offshore or Inland ≤ 100 km	Nil	Information Bulletin		
	$6.0 < M \leq 6.5$	Inland (40 km < Inland ≤ 100 km)	Nil	Information Bulletin		
		Offshore or near the coast (Inland ≤ 40 km)	Potential of weak local tsunami $\Delta eq < 100$ km	LOCAL Tsunami ADVISORY	Information	
	$6.5 < M \leq 7.0$	Offshore or Inland ≤ 100 km	Potential of destructive local tsunami $\Delta eq < 100$ km 400 km	LOCAL Tsunami WATCH	REGIONAL Tsunami ADVISORY	Information
	$7.0 < M \leq 7.5$		Potential of destructive regional tsunami $\Delta eq < 400$ km basin	REGIONAL Tsunami WATCH		BASIN-WIDE Tsunami ADVISORY
	$M > 7.5$		Potential of destructive tsunami in the whole basin any Δeq	BASIN-WIDE Tsunami WATCH		
≥ 100 km	$M \geq 5.5$	Offshore or Inland ≤ 100 km	Nil	Information Bulletin		
any	any	Inland > 100 km	Nil	Nil		
				LOCAL	REGIONAL	BASIN-WIDE

PTF in the Santorini-Amorgos area

PTF results for M7.0 scenario: offshore values at Forecast Points

Increased conservativeness



PTF p50

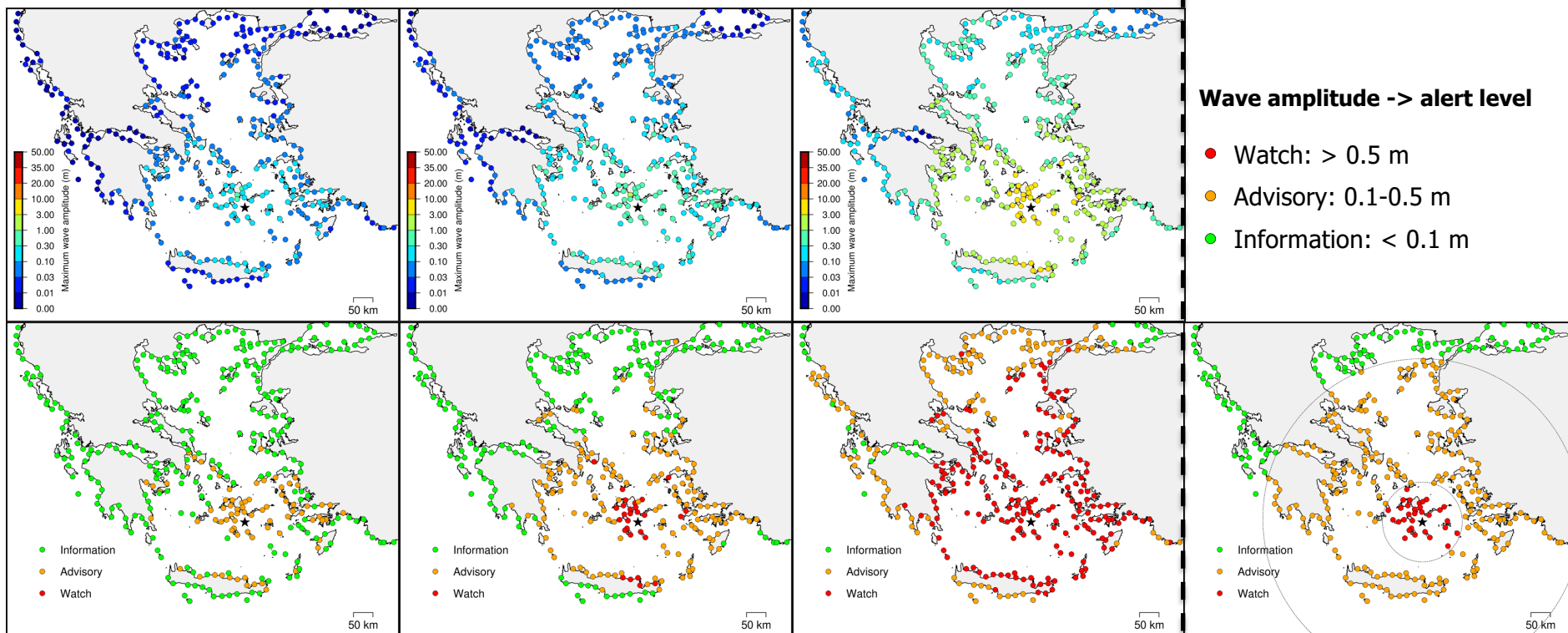
PTF p80

PTF p99

NEAMTWS Decision Matrix

Wave amplitude -> alert level

- Watch: > 0.5 m
- Advisory: 0.1-0.5 m
- Information: < 0.1 m



PTF in the Santorini-Amorgos area

PTF results for M7.3 scenario: offshore values at Forecast Points

Increased conservativeness



PTF p50

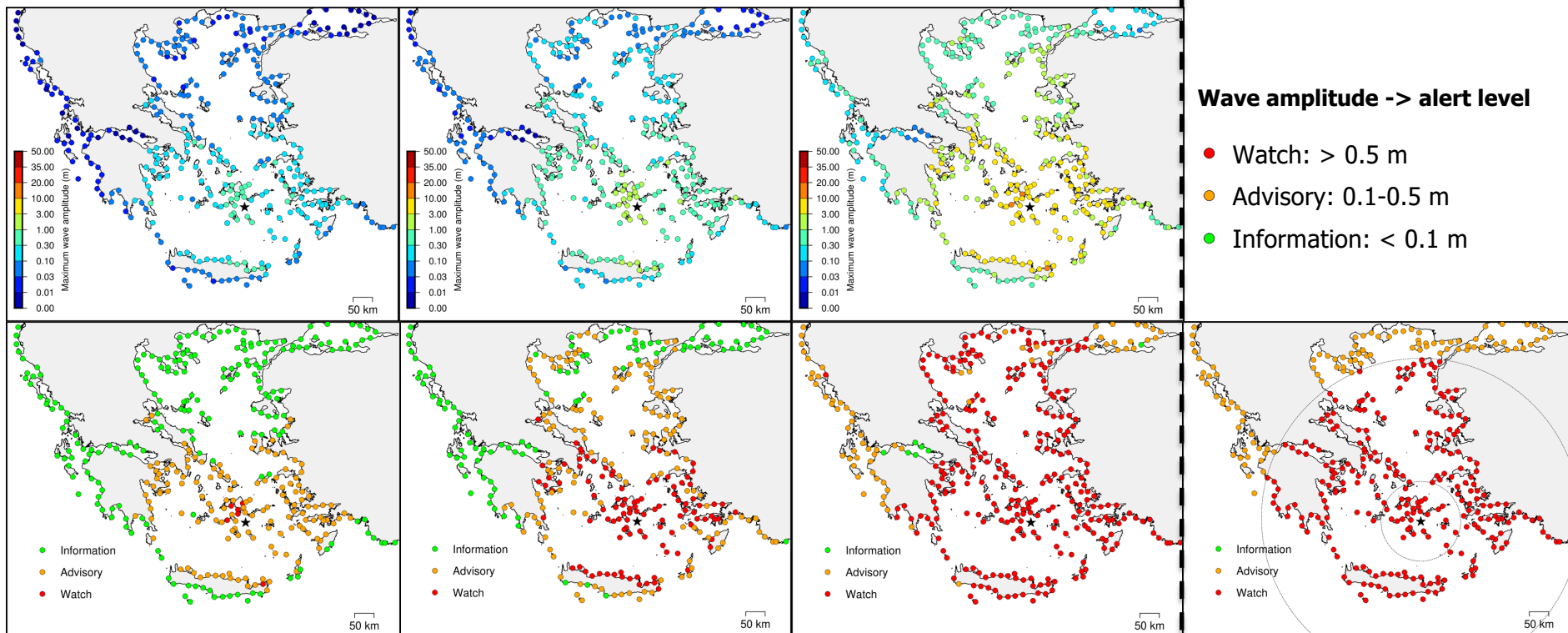
PTF p80

PTF p99

NEAMTWS Decision Matrix

Wave amplitude -> alert level

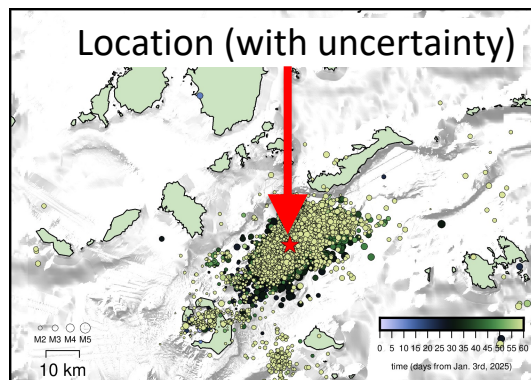
- Watch: > 0.5 m
- Advisory: 0.1-0.5 m
- Information: < 0.1 m



PTF in the Santorini-Amorgos area

How PTF is done – Tsunami propagation and impact

PTF application for the Santorini-Amorgos area, using full inundation simulations



Magnitudes:

- 7.0,
- 7.3,
- 7.5.

Number of simulations (after smart sampling)
for each magnitude at the $\sigma = 2$ level.

M7.0	M7.3	M7.5
364	398	413

Depth:

- fixed to 10 m

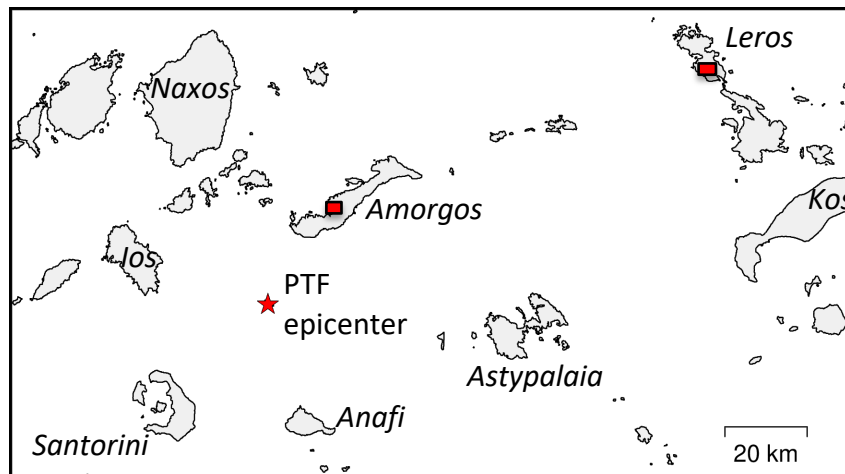
Total number of scenarios: 1175



Tsunami inundation simulations
run for two coastal locations:

- Katapola, Amorgos Island
- Lakki, Leros Island

Five-level nested grids were used,
with 12m highest-resolution.

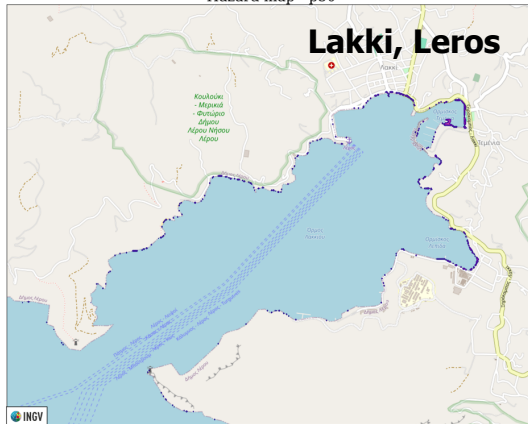


PTF in the Santorini-Amorgos area

Preliminary PTF inundation results for M7.3 scenario:
flow depth maps at selected locations

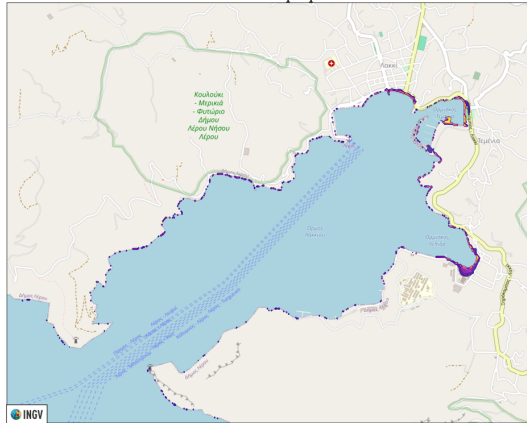
PTF p50

Hazard map - p50



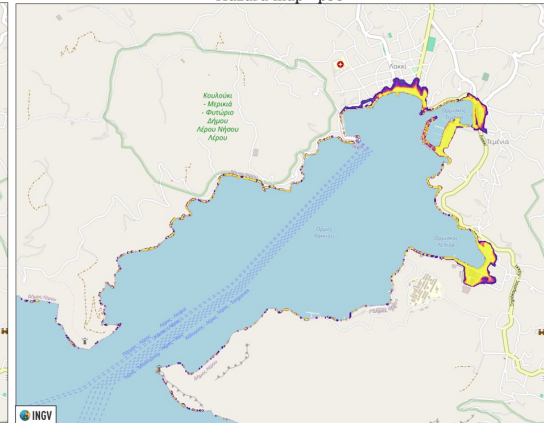
PTF p80

Hazard map - p80



PTF p99

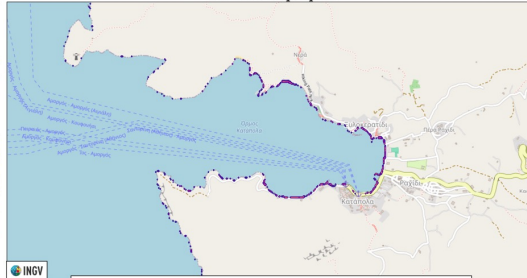
Hazard map - p99



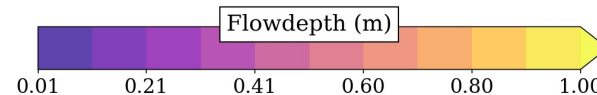
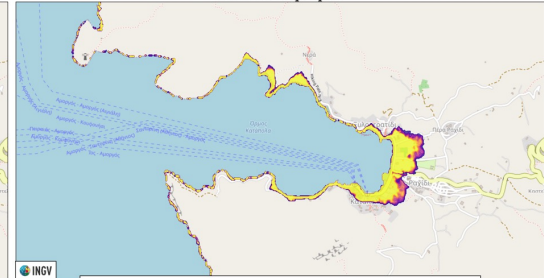
Hazard map - p50



Hazard map - p80

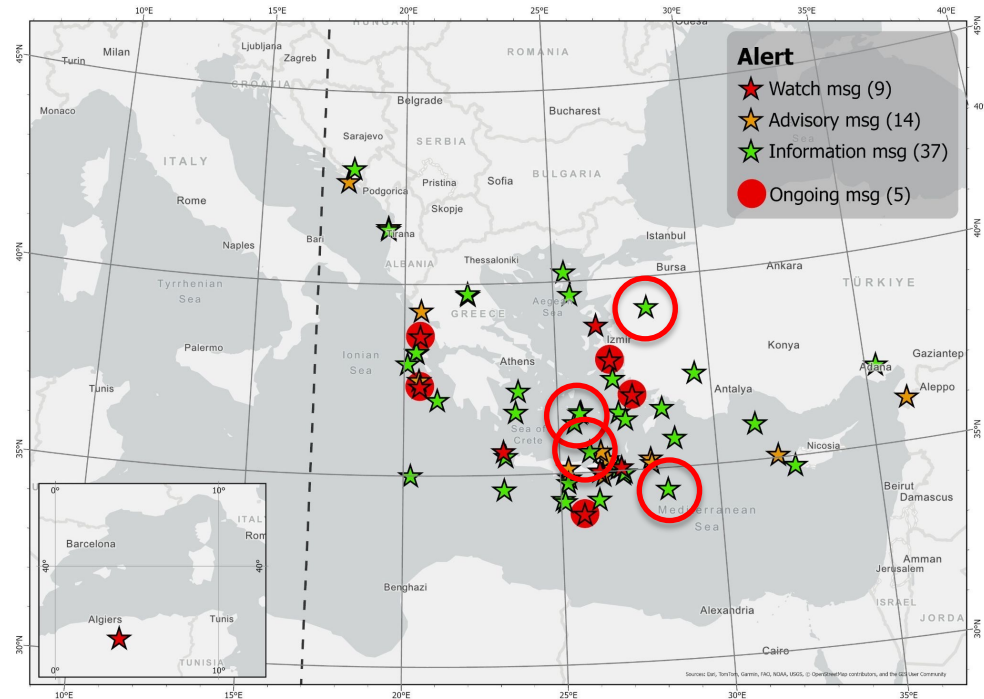


Hazard map - p99



Operational activities

Tsunami Warning Messages issued for 7 EQs in 2025



Date	Time (UTC)	Region	Lat	Lon	Magnitude	Alert Level
04-Feb-25	13:04:14	Amorgos-Santorini region	36.60	25.74	5.5	Information
09-Feb-25	19:05:38	Amorgos-Santorini region	36.32	25.52	5.5	Information
10-Feb-25	20:16:28	Amorgos-Santorini region	36.57	25.70	5.5	Information
13-May-25	22:51:15	S of Karpathos, Greece	34.97	27.05	5.9	Information
22-May-25	03:19:35	Crete, Greece	35.56	25.97	5.9	Information
02-Jun-25	23:17:28	Dodecanese Islands, Greece	36.58	28.36	5.8	Information
10-Aug-25	16:53:47	Turkey (inland, Sındırgı district)	39.22	28.10	6.2	Information

Operational activities

Tide Gauge (TG) installations

Santorini volcano-tectonic crisis



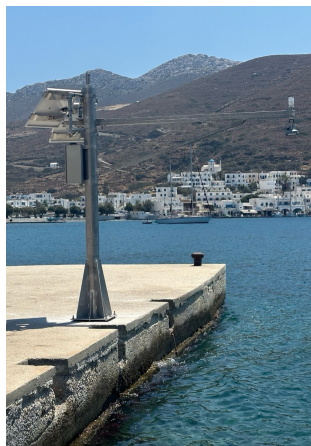
A temporary TG was installed in Santorini during the volcano-tectonic crisis, which will soon be replaced with a permanent station through national funding.

Tide Gauge (TG) installations

Climate change observatory of Delos



A TG with radar sensor was installed in Mykonos and a TG with pressure sensor, co-located with a GNSS station in Delos. The stations were installed in collaboration with the Academy of Athens, within the framework of the “Development and installation of an integrated system for monitoring the impacts of climate change on the monuments of Delos” project, funded through the institutions of the *Initiative 21* foundation.

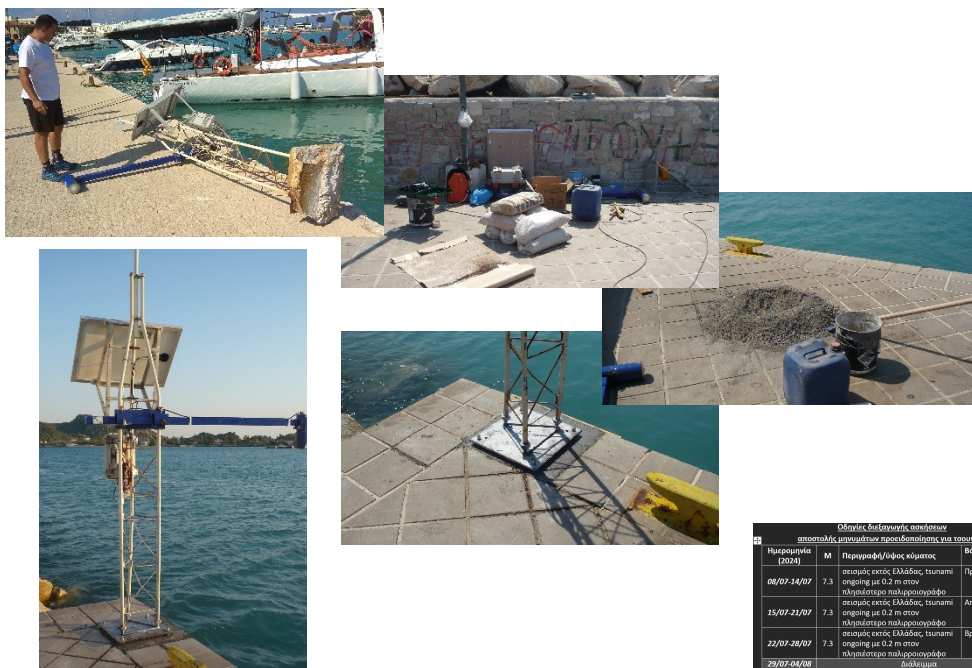


A new TG was installed in the harbor of Katapola, Amorgos Island, in collaboration with the Academy of Athens and with funding from *HelleniqEnergy*.



Operational activities

Tide Gauge maintenance on a need-to and can-do basis

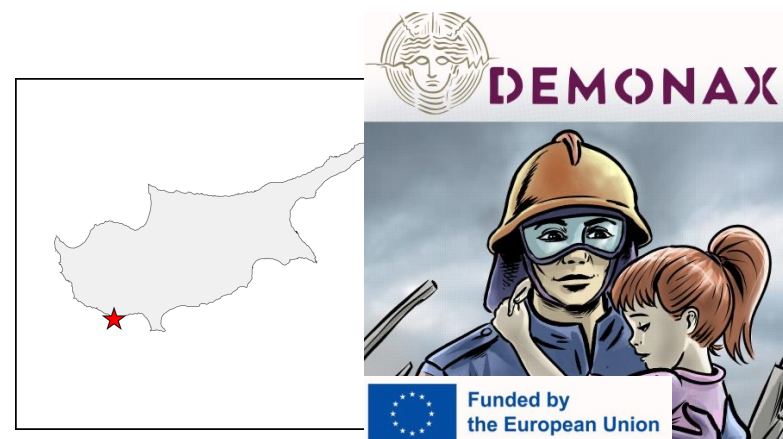


Daily scenario-based tsunami drills for internal training of the duty officers in HL-NTWC

Οδοντική διάσκεψη επίδειξης αποστολής επικοινωνίας προειδοποίησης για τσουνάμι				
Ημερομηνία (2024)	M	Περιγραφή/θέμα επίδειξης	Βαθμίδα	
04/07-14/07	7.3	σεισμός εκτός Ελλάδας, τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο	Πρωινή	
15/07-21/07	7.3	σεισμός εκτός Ελλάδας, τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο	Απογευματινή	
22/07-28/07	7.3	σεισμός εκτός Ελλάδας, τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο	Βραδινή	
29/07-04/08				
05/08-11/08	6.4	Τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο και magnitude update σε 6.6	Πρωινή	
12/08-18/08	6.4	Τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο και magnitude update σε 6.6	Απογευματινή	
19/08-25/08	6.4	Τσουνάμι ongoing με 0.2 m στον πληθυστικό μακροχρονόγραφο και magnitude update σε 6.6	Βραδινή	
26/08-01/09				
02/09-08/09	6.6	σεισμός στον Καραϊβικό, χωρίς παρατήρηση τσουνάμι	Πρωινή	
09/09-15/09	6.6	σεισμός στον Καραϊβικό, χωρίς παρατήρηση τσουνάμι	Απογευματινή	
16/09-22/09	6.6	σεισμός στον Καραϊβικό, χωρίς παρατήρηση τσουνάμι	Βραδινή	
23/09-29/09				
30/09-06/10	7.1	0.5m στον πληθυστικό μακροχρονόγραφο, 0.2m στον επείγουσα μακροχρονόγραφο	Πρωινή	
07/10-13/10	7.1	0.5m στον πληθυστικό μακροχρονόγραφο, 0.2m στον επείγουσα μακροχρονόγραφο	Απογευματινή	
14/10-20/10	7.1	0.5m στον πληθυστικό μακροχρονόγραφο, 0.2m στον επείγουσα μακροχρονόγραφο	Βραδινή	

DEMONAX Full Scale Exercise

Contribution to design of earthquake and tsunami scenario which will develop a very realistic, challenging environment for the response capacities of the Republic of Cyprus.



HL-NTWC is participating in the following projects and initiatives:

- Aristotle-eENHSP (2020 - ...)
- EPOS Tsunami TCS (2021 - ...)
- SUBMERSE (2023 - 2026)
- Geo-INQUIRE (2022 - 2026)
- DEMONAX earthquake and tsunami Full-Scale Exercise in Cyprus (2024 – 2026)
- EPOS-ON (2024 - 2027)
- TRANSFORM2 (2024 - 2027)
- NEAM-COMMITMENT (2025 - 2027)

Participation in workshops and meetings



- 18th Meeting of the Working Group on Tsunamis and Other Hazards related to Sea Level Warning and Mitigation Systems (TOWS-WG-XVIII), Paris, France, January 2025.
- Online Scientific Meeting on Santorini, organized by IOC/TRS, February 2025.
- UNESCO-IOC Expert Meeting on Tsunami sources in the NEAM region, within the framework of the CoastWAVE 2.0 Project, Paris, France, March 2025.
- Project-related meetings (e.g., NEAM-COMMITMENT, DEMONAX, Multi-Marex, etc.).
- In-person (Lisbon) and online NEAMTWS inter-TSP meetings, co-organized between TT-OP and TT-DOC.
- EPOS TCS-TSUNAMI meetings (in person in Athens, and online).
- GTM in-person meeting in Athens, October 2025.
- Ocean Decade Tsunami Programme and International Tsunami Symposium in-person meetings in Hyderabad, India, October 2025.
- NEAM Regional Webinar on Tsunamis Generated by Non-Seismic Sources, November 2025.



- The tender for the purchase of **12 new tide gauges** and **new server** for the **pilot implementation of PTF** is progressing – expected installations in 2026.
- **Pilot implementation of PTF** in collaboration with CAT-INGV – ongoing.
- Signing an agreement with CAT-INGV for the **collaborative installation and operation** of 2 new tide gauge stations, in the Ionian Sea – ongoing.
- Development of a **national tsunami warning page** to publish information related to tsunami events for the public – ongoing.
- Development of a **new platform for acquisition, storage and presentation of raw real-time and quality-controlled sea level data** from NOA's tide gauge network – ongoing.

Ongoing developments

- The Institute of Geodynamics has moved to a new building in Penteli, in the northern outskirts of Athens. The seismic and tsunami monitoring room will be moved to the new premises later on, perhaps within the next year.



Images source: <https://www.iefimerida.gr/design/neo-ktirio-geodynamiko-institoyto-penteli>


Awareness activities

- **Researchers' night** – September 2025







New LinkedIn account

*“Hellenic National Tsunami Warning Center
HL_NTWC”*



**Hellenic National Tsunami Warning Center
HL_NTWC**
Add verification badge
Hellenic National Tsunami Warning Center at National Observatory of Athens
Athens, Attiki, Greece · [Contact info](#)

 Hellenic National Tsunami Warning Center HL_NTWC posted this • 1mo Samos, October 30, 2020 – From Memory to Preparedness Five years ago today, a magnitude 7.0 earthquake struck the ...show more	1,861 Impressions 7 reposts	View analytics
 Hellenic National Tsunami Warning Center HL_NTWC posted this • 1mo Hellenic National Tsunami Warning Center HL_NTWC is honored to participate in the GIM & GIM-TCS Tsunami Synergy Meeting in Athens (21-23 October 2025)...show more	1,378 Impressions 9 reposts	View analytics
 Hellenic National Tsunami Warning Center HL_NTWC posted this • 1mo NEAM-COMMITMENT EU Project Launches Multi-Hazard Workshop on Stromboli Island – Day 1 ...show more	919 Impressions 5 reposts	View analytics
 Hellenic National Tsunami Warning Center HL_NTWC posted this • 1mo NEAM-COMMITMENT EU Project Advances Multi-Hazard Workshop on Stromboli Island – Days 2 & 3 October 8-9, 2025 ...show more	832 Impressions 3 reposts	View analytics

- Tsunami awareness activity for the public



WTAD - a LinkedIn post

5 November 2025



BE TSUNAMI READY
INVEST IN TSUNAMI PREPAREDNESS
WORLD TSUNAMI AWARENESS DAY
– 5 NOVEMBER 2025

Hellenic National Tsunami W...
It's World Tsunami Awareness Day!
Tsunamis don't wait. But we can be ready.
This day, November 5th, we honor the power of preparedness and the strength of communities that choose safety, solidarity, and resilience. Whether you're inland or on the shore, tsunami preparedness is a shared responsibility.
Let's continue learning, practicing, and empowering one another, because when the wave comes, it's our unity that saves lives.
Let's turn awareness into action. Let's make safety visible, inclusive, and unstoppable.
Elena Daskalaki and 18 others · 4 reposts
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* **thank
you**
