

TSP-TURKEY

Report for NEAMTWS-XVII

24-26 November 2021

1. Overview of operational status

Kandilli Observatory and Earthquake Research Institute's (KOERI) Regional Earthquake and Tsunami Monitoring Centre (RETMC), as the NTWC for Turkey, is an ICG/NEAMTWS accredited 24/7 operational TSP. KOERI-RETMC continued its services without any interruption during the intersessional period. COVID-19 had no impact on TSP operations thanks to necessary arrangements and preventive measures undertaken by the RETMC management in coordination with KOERI Directorate. KOERI's service area, Decision Matrix, seismic and sea-level network is presented in Figures 1 to 4, respectively.

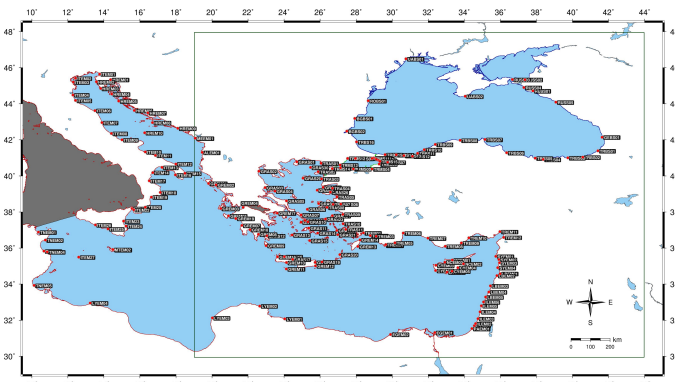


Figure 1: KOERI-TSP Service Area (blue) and TFPs. Green rectangle indicates earthquake monitoring area.

TSP-TR (KOERI)						
Decision Matrix for the Eastern Mediterranean, Aegean and Black Seas						
Depth	Epicentre Location	Earthquake Magnitude	Tsunami Potential	Type of Tsunami Message		
				Local	Regional	Basin-wide
				< 100 km	100 - 600 km	> 600 km
< 100 km	Offshore or close to the coast (≤ 40 km inland)	5.5 ≤ Mwup or mb ≤ 5.9	Low tsunami potential	Information	Information	Information
		6.0 ≤ Mwup ≤ 6.4	Tsunami potential	Advisory	Information	Information
	Offshore or close to the coast (50-100 km inland)	6.5 ≤ Mwup ≤ 6.9	Potential for a destructive tsunami	Watch	Advisory	Information
		7.0 ≤ Mwup or Mwep ≤ 7.4	Potential for a destructive tsunami	Watch	Watch	Advisory
	Inland (≥ 40 km and < 100 km)	Mwep ≥ 7.5	Potential for a destructive tsunami	Watch	Watch	Watch
≥ 100 km	Offshore or inland (≤ 100 km)	6.0 ≤ Mwup ≤ 6.4	Low tsunami potential	Information	Information	Information
		Mwup ≥ 6.0	Low tsunami potential	Information	Information	Information
NEAMTWS Decision Support Matrix						
Alert Level				Advisory	Watch	
Wave Amplitude				0.3-0.5 m	> 0.5 m	
Run-up				< 1 m	> 1 m	
Impact				Current, bore, damage in water	Watch impact + inundation of the possible minor inundation in beaches	
					Watch impact + inundation of the low-lying coastal land	

Figure 2: KOERI Decision Matrix

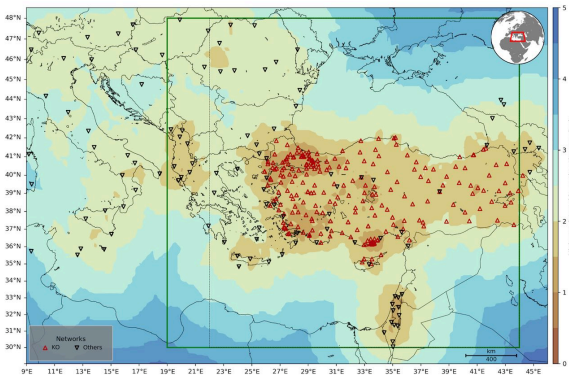


Figure 3: Seismic stations integrated in KOERI-TSP and resulting minimum earthquake magnitude detection threshold map.

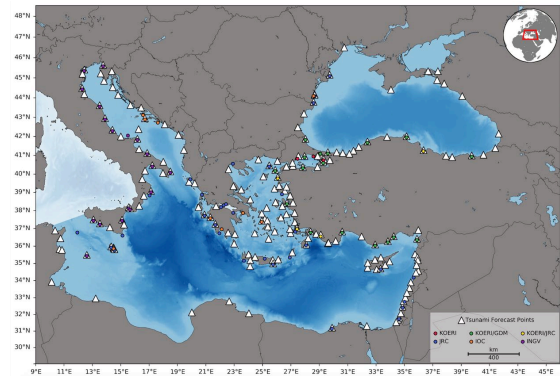


Figure 4: Sea-level stations integrated in KOERI-TSP.

2. Internal and communication test exercises

Duty officers of the RETMC continued to perform internal exercises of the Tsunami Warning System on a daily basis at each shift using TsuComp (an improved version of the FP-7 Project ASTARTE deliverable). The success rate of these internal exercises is about 97%. A full-back-up of TsuComp is maintained and tested regularly at KOERI. In addition, KOERI continued to perform Communication Test Exercise with AFAD (Turkish CPA) and its subscribers on every Monday and Tuesday of every first full week of each month, respectively. All activities were subjected to continuous-regular internal performance monitoring procedures. At the current stage, RegCTEs are very useful to identify and address any issue related to the Message Dissemination. However, there is no ICG/NEAMTWS mechanism established for the evaluation of these RegCTEs. This is a primarily TSP task. The feedback to these exercises is found to be poor and

problematic. Recipients report local time instead of UTC, and general confusion about message receipt times are being observed. Times are not reported at all in some cases.

3. Seismic monitoring

REMTTC operates a seismic network including 256 sensors that comprise broadband (BB), accelerometer (SM) and short-period (SP) seismometers. Sensor numbers exceed 350 when including other national and international institutes operating and distributing data around the Mediterranean Region. A bilateral agreement on seismic data exchange between KOERI and INGV has entered into force in 2019. The average data availability performance of KOERI’s seismic network was above 80% throughout the intersessional period, despite the negative impact of the COVID-19 related restrictions in maintenance duty travels.

4. Sea-Level monitoring

At the national level, 18 out of 20 tide-gauge radar type stations operated by the General Directorate of Mapping (GDM) are integrated in the TSP operations. The remaining 2 stations are expected to be integrated in 2021 after finalization of their upgrades. Four IDSL stations donated by EC-JRC have been installed in Fethiye, Bozcaada, Samsun, and Bodrum, where the latter was installed as part of the Last Mile Project. Currently Fethiye (IDSL) tide-gauge is defect and awaiting maintenance. In total, 78 sea level stations are available in near real-time for the purposes of TSP operations (IDSL-JRC 33, General Command of Mapping 18, INGV 18, IOC 9). Recalling the recognition of the importance of real-time sea-level data exchange for completing the NEAMTWS by the ICG/NEAMTWS at its previous sessions, KOERI hopes to achieve bilateral agreements for sea-level data exchange, similar to the one between KOERI and INGV entered into force on 27 April 2018, with other NEAMTWS TSPs in the near future.

Major sea-level data transmission problem was encountered during 13 September – 3 November 2021, even though data was available internally. The problem was related to the SQL server which we were not able to identify. Data transmission to IOC and INGV has been restored on 3 November 2021 through html protocol.

5. Messages disseminated and operational performance

During 2021, KOERI continued to disseminate enhanced products (Travel Time, Tsunami Forecast Point Alert Levels, and Distance Based Alert Level Maps) to its subscribers. Within the same period, as of reporting date, there were 6 messages (2 ADVISORY, 4 INFORMATION) disseminated by KOERI. A summary table of these events together with the reflection of KOERI’s own performance assessment in colour code is presented below. KOERI’s performance grade is 3.6/4.0 for 2021 as of the submission of this report.

Date	UTC Time	Location	Latitude (KOERI)	Longitude (KOERI)	Latitude (USGS)	Longitude (USGS)	Δ Epicenter (ΔE)	Δ Hypocenter (ΔH)	Depth (KOERI)	Depth (USGS)	Δ Depth (ΔD)	Magnitude (KOERI-TSP)	Magnitude (USGS)	Δ Magnitude (ΔM)	Alert Level	Latency (min)
03.03.2021	10:16	Greece	39.8	22.16	39.7546	22.1757	5.2	5.6	10	8.0	2	6.3 Mwp	6.3 mww	0.0	INFORMATION	9
21.06.2021	22:14	Dodecanese Islands	36.37	27.08	36.4391	27.0416	8.4	8.9	12	9.0	3.0	5.6 Mwp	5.5 mww	0.1	INFORMATION	8
01.08.2021	04:31	Dodecanese Islands	36.34	27.06	36.3958	27.0112	7.6	10.2	17	10.1	6.9	5.8 Mwp	5.6 mww	0.2	INFORMATION	8
27.09.2021	06:17	Crete	35.17	25.22	35.2444	25.2897	9.4	10.2	10	6.0	4	6.1 Mwp	6.0 mww	0.1	ADVISORY	13
12.10.2021	09:24	Crete	34.91	26.26	35.1693	26.2163	29.1	29.5	15	20.0	-5	6.2 Mwp	6.4 mww	0.2	ADVISORY	6
19.10.2021	05:32	Crete	34.46	28.35	34.5883	28.3882	14.7	14.6	10	41.5	13.5	6.0 Mwp	5.9 mww	0.1	INFORMATION	9

Legend				
Latency (min)	≤ 7 min	< 7-10 ≤ min	< 10-15 ≤ min	> 15 min
ΔM (USGS-KOERI)	≤ 0.1	0.1 < ΔMdiff ≤ 0.2	0.2 < ΔMdiff ≤ 0.3	> 0.3
ΔD, ΔE, ΔH (USGS-KOERI)	≤ 10 km	10 km < ΔMdiff ≤ 20 km	20 km < ΔMdiff ≤ 30 km	> 30 km
Alert Level	CORRECT		WRONG	
Performance Level	Good	Acceptable	Poor	Bad
	4	3	2	1

Figure 5: Events during the period where tsunami messages were disseminated. Colour code refers to alert levels and performance.

Due to an infrastructure problem effecting primary and backup communication channels, KOERI–TSP services were interrupted for 6h on 2 July 2021. On 28 July 2021, a ‘cancellation’ message was sent out erroneously as a real message by the duty officer during a regular internal tsunami exercise.

6. Awareness Activities

In accordance with the administrative decision of Boğaziçi University dated 11 March 2020, all physical training and educational activities of KOERI’s Disaster Preparedness Laboratory (DPL) and RETMC has been ceased due to COVID-19 pandemic until further notice. A public webinar by Boğaziçi University on tsunami preparedness took place 8 December 2020 as part of its “Open Lecture” programs. Three online seminars targeting Istanbul Metropolitan Municipality representatives took place on 21 May 2021 (by METU), 12 August 2021 and 10 September 2021 (by KOERI).

Another online seminar has also been organized by Istanbul Metropolitan Municipality targeting to increase tsunami awareness in one of the secondary schools in Istanbul. METU contributed to online panel organized by National Commission of UNESCO on the subject of Ocean Decade held on 24 August 2021, in which "Marine Hazards and Tsunami Ready Activities" are presented and discussed by Prof. Ahmet Cevdet Yalciner (METU). In the opening session of the panel Mr. Julian Barbière from IOC secretariat introduced the IOC activities for Ocean Decade 21.

KOERI contributed to the WTAD activity organized on 5 November 2021 jointly with Istanbul Metrolopolitan Municipality and Middle East Technical University. The activity was in the form of a awareness seminar at IMM premises including both physical and remote participation. The seminar was attended by high-level officials from IMM and included presentations on basics of tsunami hazard and risk (by Prof. Dr. A. Cevdet YALÇINER METU), implementation of tsunami action plan of Istanbul (by Kemal Duran – IMM Directorate of Soil and Earthquake, KOERI's TWS and İstanbul's tsunami resilience from a multi-hazard perspective (by Dr. Öcal Necmioğlu-KOERI), and real-time tsunami monitoring system in Japan (by Prof. Dr. Yoshiyuki Kaneda, Kagawa University/JICA). The event hosted also a physical and virtual exhibition of paintings on tsunami theme from primary school students in Istanbul.



Figure 7: Images from WTAD activity on 5 November 2021.

7. NEAMWave21

For NEAMWave21, KOERI and National Observatory of Athens (NOA) have combined their efforts through a joint scenario in the Eastern Mediterranean based on a M7.7 earthquake along the western segment of the Cyprian Arc. The modelling of the KOERI-NOA scenario had been done by KOERI through the Easy Wave tsunami modelling tool embedded in GFZ's TridecCloud®, which is a cloud- and web-based prototype Tsunami Early Warning Decision Support platform based on the experiences and the knowledge gained in various research projects. During the conduct of the exercise, TridecCloud® was also utilized for the real-time simulation of the sea-level readings KOERI's enhanced products were appreciated once again by the participants.

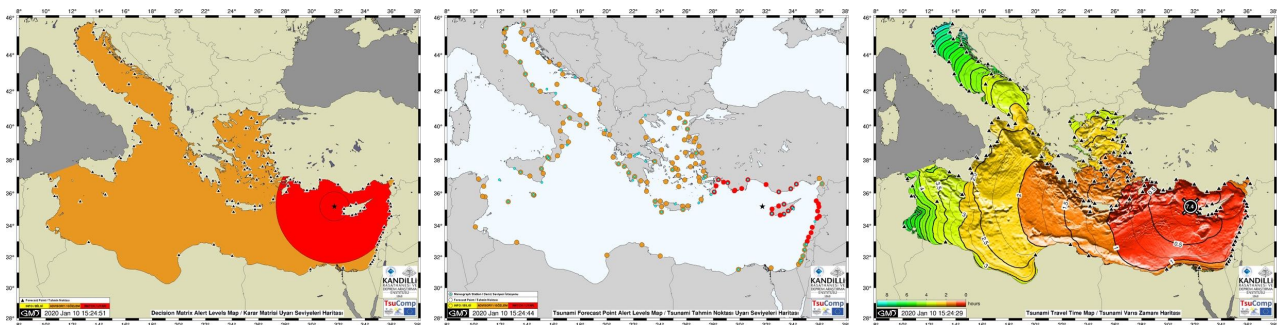


Figure 8: KOERI's enhanced products disseminated at NEAMWave21. Service Area Alert Level Map (left), TFP Alert Level Map (centre), Tsunami Travel Time Map (right).

8. EPOS-TCS

KOERI welcomes and is following closely the development of a TSUNAMI-TCS under EPOS as a supporting and complementing action to the NEAMTWS, especially with the understanding that EPOS TS-YCS will never have any intention or future de-facto status of replacing/substituting/introducing any governance and/or technical mechanisms that may be seen as controversial to the ICG/ NEAMTWS.

9. Tsunami Ready

During the first WG4-Tsunami Ready Group Meeting on 6 April 2021, KOERI presented an overview of what has

been achieved during the Last Mile Turkey Project completed in 2019 with the support of EC-JRC and in partnership with Middle East Technical University (METU) focusing on Bodrum in light of the experience of 20 July 2021 Mw 6.6 Bodrum-Kos earthquake and tsunami. The Last Mile Turkey project implemented in Bodrum contributed to the development of some TR indicators/ TR "elements" (preparation of high-resolution tsunami inundation and evacuation maps, awareness and preparation activities, such as seminars and workshops, a tsunami exercise in Bodrum). Hence, Bodrum has a great potential to be identified as a possible Tsunami Ready location in Turkey. Due to their geographical proximity and degree of similarity in tsunami risk, Didim, Marmaris, Fethiye and Kaş were identified as additional potential Tsunami Ready candidates. In addition, significant progress has been made in Istanbul, where tsunami modelling, vulnerability and hazard analysis reports have been prepared for each coastal municipality and published online by the Istanbul Metropolitan Municipality in close cooperation with METU. Tsunami action plan and district-based tsunami risk analysis, inundation and evacuation maps are publicly available at the following links:

<https://depremezmin.ibb.istanbul/guncelcalismalarimiz/#istanbul-tsunam-eylem-planı>

<https://depremezmin.ibb.istanbul/guncelcalismalarimiz/#le-tsunam-blg-ktapiklari>

As communicated during the second meeting of WG4-Tsunami Ready Group on 30 June 2021, Prof. Dr. Ahmet Cevdet Yalçın from METU was nominated on 5 July 2021 as an additional member of WG4-Tsunami Ready Group. His expertise as one of the previous vice-chairs and chairs of the ICG/NEAMTWS and direct involvement in the preparation of the tsunami hazard, inundation and evacuation mapping both in Bodrum during the Last Mile-Turkey project and also for Istanbul Metropolitan Municipality, makes him a strong and unique candidate as a member of this group.

In September 2021, Istanbul Metropolitan Municipality begun with the installation of tsunami evacuation signages in Büyükçekmece district in the European part of Istanbul as a pilot project. The municipality aims to finalize the installation of tsunami evacuation signages in all coastal districts facing Marmara Sea by the end of 2022.

On 5 October 2021, KOERI has communicated IOC Tsunami Secretariat our confirmation of support and interest in the involvement in the "Strengthening the Resilience of Coastal Communities in the North-East Atlantic and Mediterranean Region to the Impact of Tsunamis and Other Sea Level-Related Coastal Hazard" project jointly undertaken by DG-ECHO and IOC Tsunami Secretariat. This project is expected to play a key role in the adaptation of Global Tsunami Ready Standards and Guidelines and pilot Tsunami Ready within the framework of the ICG/NEAMTWS. Prof. Dr. Ahmet Cevdet Yalçın has been nominated as the in-country liaison/focal point for the project. One important achievement was the agreement we have received from Istanbul Metropolitan Municipality regarding their participation in this initiative. In addition, based on important achievements made thanks to the "Last Mile-Turkey" project in Bodrum executed in 2019, we anticipate similar support from the Bodrum Municipality and we are hopeful to inform the ICG/NEAMTWS positively at its upcoming session. In addition to the Istanbul Metropolitan and possibly Bodrum Municipality, key national stakeholders and partners are expected to be AFAD (Disaster and Emergency Presidency), İstanbul and Muğla Provincial Directorates of AFAD, and Bodrum Governorate. Engagement of relevant NGO's is considered to be a possibility.

11. Ocean Decade

Our "National Decade Committee on Ocean Decade" has been established and the "national kickoff event" was carried out on 24 Aug 2021 (via remote video call) under the coordination of UNESCO Turkey National Commission and our Office of Navigation, Hydrography and Oceanography."

12. Manuscript on KOERI-TSP

A manuscript with the title of "KOERI's Tsunami Warning System in the Eastern Mediterranean and Its Connected Seas: A Decade of Achievements and Challenges" has been submitted to MDPI Applied Sciences Special Issue: "Advanced Measures for Earthquake and Tsunami Disaster Mitigation" and is currently under editorial process.

Dr. Öcal Necmioğlu
IOC/ICG/NEAMTWS TNC for Turkey
on behalf of KOERI-RETMC Team
22 November 2021