# Insights from the Methana Magmatic Observational Experiment (MeMaX)

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## Introduction

The **Methana Magmatic Observational Experiment (MeMaX)** investigates the dormant Methana and Pausanias volcanic systems located in the western **Saronic Gulf** (Fig.1). These magmatic complexes pose **potential hazards** due to their proximity to populated areas like Athens. Methana's last eruption occurred around 230 BCE and there are ongoing thermal and hydrothermal activities[1].

The **South Aegean Volcanic Arc** (Fig. 1B) is known for its complex volcanic history and extensional tectonics[2]. Since 2019, a permanent seismic network has been deployed to detect **microseismic events.**

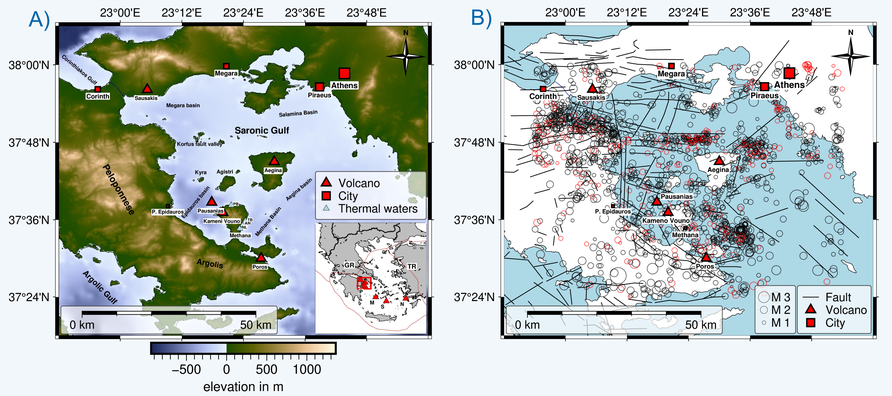



**Figure 1:** *A) Overview of the study area Saronic Gulf, Greece B) Seismic activity detected by the NOA (2019-2025) in the Saronic Gulf and the corresponding research area. Black lines indicate main faults[3].*

## MeMaX Network

The temporary network (1A), deployed in spring 2024, supplements the existing stations by adding 15 **short-period seismic stations** located across the Methana Peninsula, nearby islands, and the Peloponnese mainland (Fig.3).

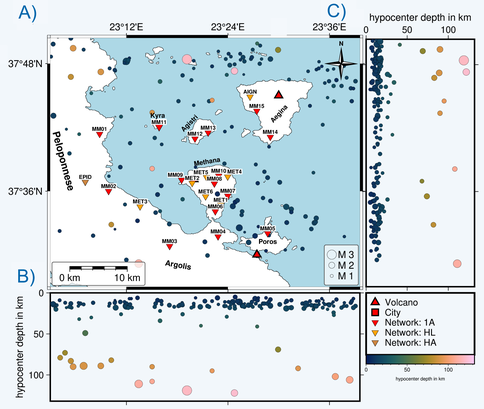
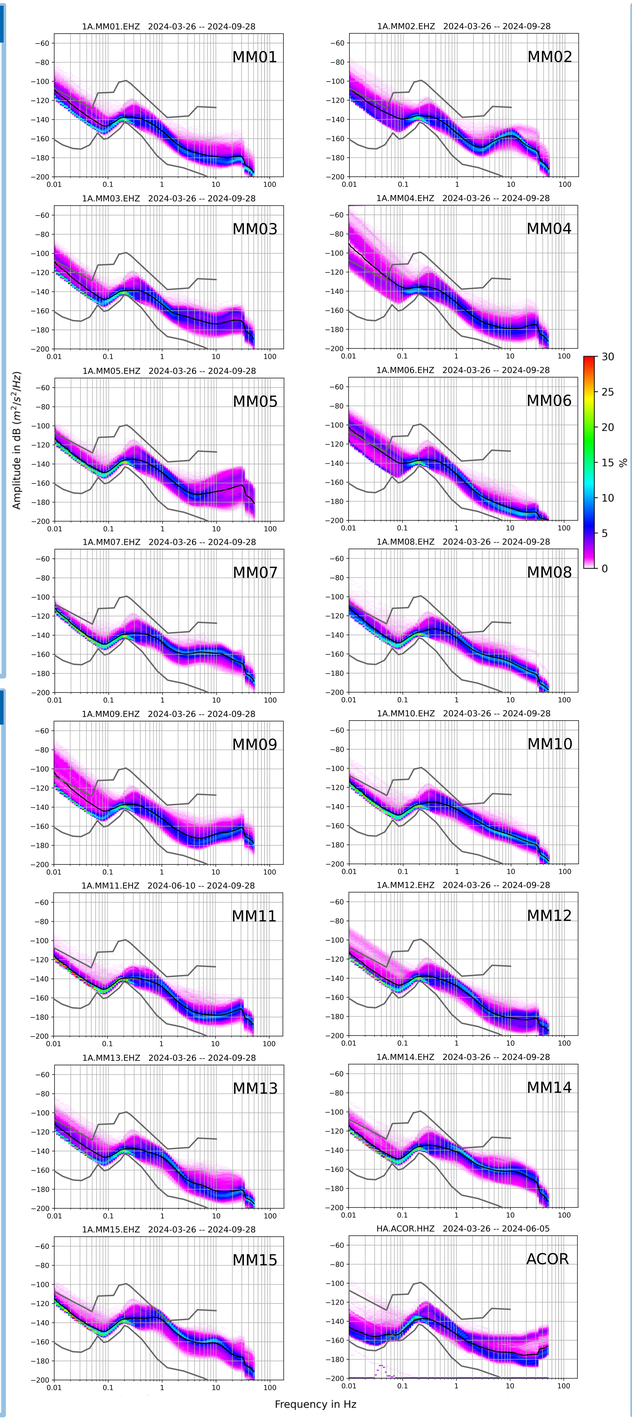



**Figure 2:** *A) Map of all available seismic recording stations from the networks HL, HA, and 1A. The hypocenters outline the ongoing seismic activity detected by the National Observatory in Athens since the deployment of the MeMaX network (27 March 2024) until 6 April 2025, B), and C) depth slices.*


The temporary stations are equipped with MARK L-4C-3D seismometers and low power DiGOS DATA-CUBE3 recorders, both designed for **efficient remote operation**. The stations are powered by 12 V batteries charged via solar panels (Fig. 3). Precise orientation and time synchronization ensure high-quality data collection.

**Figure 3:** *Pictures of the instrumentation: A) Foundation for better surface coupling, B) seismometer packed into bags, C) thermal insulation, D) Equipment box, E) separated holes for equipment and seismometer, F) station MM09 with solar panel and warning sign at the GPS post.*




## First Results

The primary goal of MeMaX is to detect **microseismicity in the Methana region** with a noise threshold as low as possible (Fig. 4), which is critical to identify magmatic **deep low-frequency (DLF) seismic events**. Most stations operate below -160 dB in the frequency range 1-10 Hz (Fig. 5). Stations MM06, MM12, and MM13 have the lowest noise levels, providing ideal conditions for detecting small magnitude seismic events (Fig. 7A). Figure 6 shows clear recordings of seismic phases from the **Mw 7.2** earthquake under Taiwan. Despite the long epicentral distance (>9,000 km), P and PcP phases were recorded across the network, which can be used for teleseismic tomography or receiver function studies.

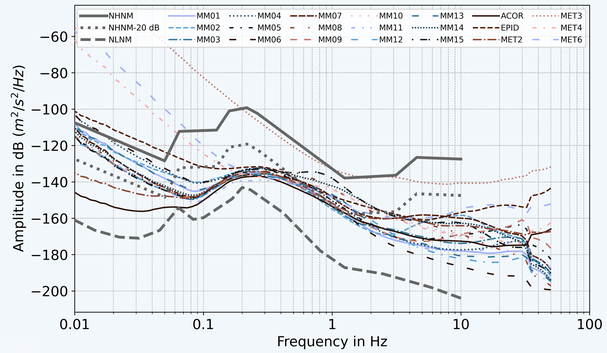



**Figure 5:** *Median levels of PPSDs for all stations in the MeMaX network. The gray lines show the new high and low noise models (NHNM, NLNM) as proposed by Peterson, (1993)) as well as the 20 dB reduced NHNM.*

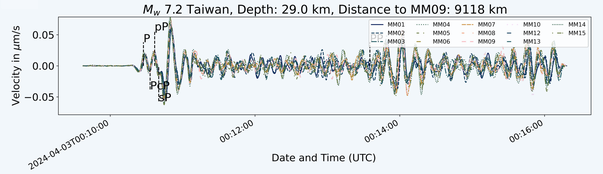



**Figure 6:** *Waveform recordings for a teleseismic earthquake, showing the vertical channels with the first arrivals of the Mw 7.2 earthquake under Taiwan*

The network successfully detected **local events** down to **a magnitude close to 0** (Fig. 7A). In addition to local events, the MeMaX network recorded **deeper seismic events** related to subduction zone (Fig. 7B).

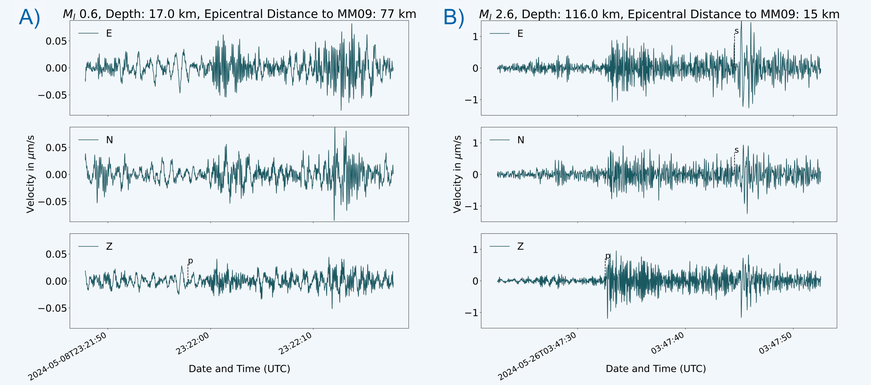



**Figure 7:** *Three-component waveform recordings for four local earthquakes measured at station MM09.*

## Conclusion

The MeMaX project established a seismic network that shows promising early results. Its capability to detect **both low-magnitude local earthquakes and teleseismic events** offers valuable insights into the ongoing magmatic and tectonic activities in the Saronic Gulf.

**Publication:**

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**References**

[1] D'Alessandro et al., 2008
[2] Papanikolaou, 2021
[3] Stefatos et al., 2002; Skourtsos and Kranis, 2009; Foutrakis and Anastasakis, 2020; Tzanis et al., 2020

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Abstract: