Deploying a Portable Infrasound Station in Jordan: Enhancing SHI Monitoring and Preparedness

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ABSTRACT

The Dead Sea Transform Fault (DSTF) have historically produced seismic events, positioning Jordan as a crucial location for monitoring infrasound waves generated by both natural phenomena, Man-Made activities, including mining quarries.

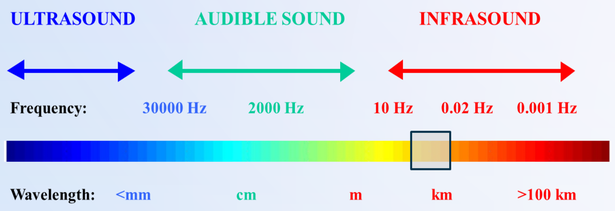
This poster examines the feasibility and strategic importance of deploying a portable infrasound station in Jordan. The proposed station aims to enhance the existing seismic monitoring infrastructure by improving the detection and analysis of infrasound signals. Key considerations include the geological significance of the DSTF and Wadi Araba Fault, which contribute to regional seismic activity and infrasound generation.

Man-Made sources, such as phosphate mining and nearby conflict zones emphasize the necessity for comprehensive infrasound monitoring in Jordan. Practical aspects of the site survey include assessing accessibility, safety, environmental conditions, and infrastructure requirements essential for establishing and maintaining the infrasound station. Additionally, this initiative offers an opportunity for capacity building within Jordan's National Data Center (NDC), enhancing expertise in infrasound technology and promoting international collaboration in SHI monitoring efforts. In conclusion, establishing a portable infrasound station in Jordan promises to enhance regional seismic monitoring capabilities, improves preparedness for natural and anthropogenic events, and contributes valuable data to global scientific infrasound researches.

Introduction:

Infrasound waves are acoustic waves with too low frequency (<20Hz) to be detected by the human ear. They travel at sound speed, 343 m/s at 20°C in air (Mutschlecner & Whitaker, 2010).

The wavelength of infrasound wave is ranging from tens of meters at 10 Hz to several tens of kilometres near 0.01 Hz. Under specific atmospheric conditions they can propagate for thousands of kilometres (CTBTO)



Infrasound monitoring is one of four technologies in the International Monitoring System (IMS) for the Comprehensive Nuclear Test Ban Treaty (CTBT), adopted by the UN in 1996 and involving 170 countries.

The International Monitoring System (IMS) infrasound network consists of 60 stations distributed around the globe (Figure 1)

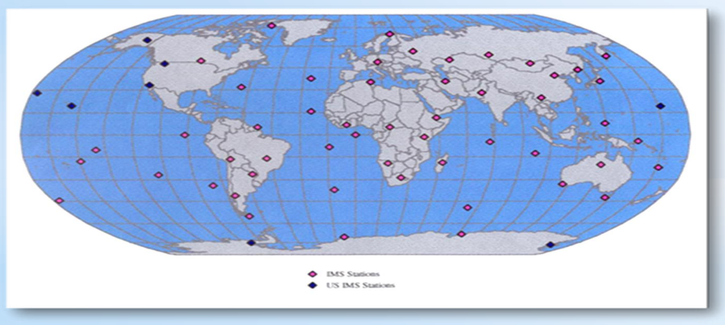


Figure 1. The International Monitoring System (IMS) Infrasound

Sources of Infrasound Waves in Jordan

Jordan has several sources of infrasound; natural and artificial activities.

1. Earthquakes:

The Dead Sea Transform Fault (DSTF) runs through Jordan and is an active fault. It stretches about 1,000 km from the northern Red Sea to the Taurus Mountains, with left-lateral movement of 5–7 mm/year. This fault causes frequent earthquakes, contributing to infrasound (Figure 2).

2. Artificial Explosions:

Jordan contains many mines and quarries that use explosives to extract minerals like phosphates and limestone. These blasts can create significant seismic activity. For example, quarry blasts can register magnitudes of up to 2.8 on the Richter Scale. Figure (3) shows mining sites in Jordan.

3. Explosions from Conflicts:

Many explosions resulting from conflicts in the surrounding areas also are considered as a source of infrasound

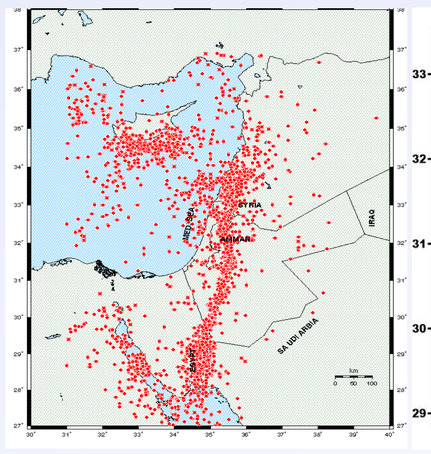


Figure 2. Earthquakes distribution along the Dead Sea Fault and surrounding area

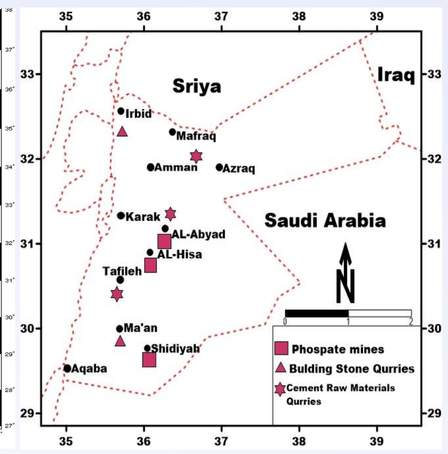


Figure 3. Locations of mines and quarries in Jordan

The Importance of the Infrasound Station in Jordan for accurate event monitoring

Many events are detected by the CTBTO WEB PORTAL, but they are not detected by the seismic network (JSO) in Jordan (Table 1 and Figure 4).

Having an infrasound station in Jordan, in addition to the seismic network, could help detect events and pinpoint their location more accurately.

Table 1. Recorded events by CTBTO WEB PORTAL infrasound stations

Event	Date	Detected Stations
Event 26454607 Jordan- Syria Region	20-07-2024 11:39:34	I26DE, I43RU, I11CV
26556672 Dead Sea Region	08-08-2024 13:50:29	I48TN, I32KE, I46RU

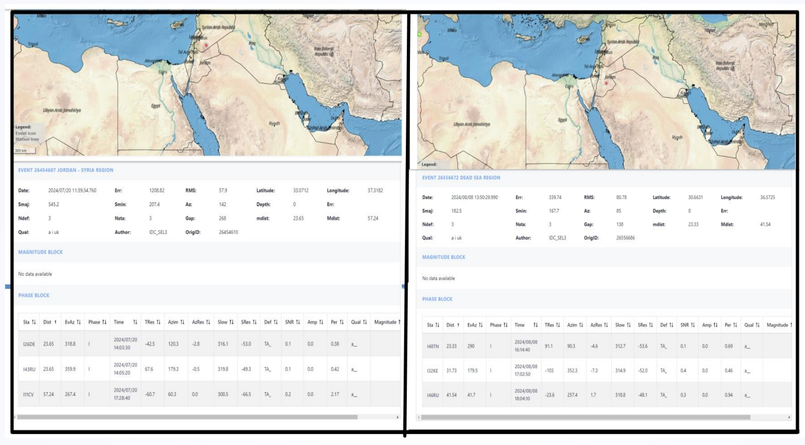


Figure 4. Recorded events by CTBTO WEB PORTAL infrasound stations

On the other hand, by checking the CTBTO WEB PORTAL it is noticed that event 26842681 Dead Sea Region- 16:41:17 detected by some infrasound stations: I19dj, I48tn, I32KE, I46RU on October 1, 2024.

JSO recorded the same event but the location is not precisely determined. (Figure 5 & 6)

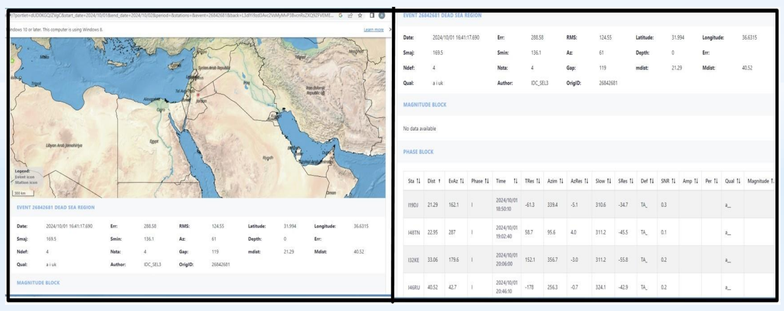


Figure 5. Recorded events by CTBTO WEB PORTAL infrasound stations

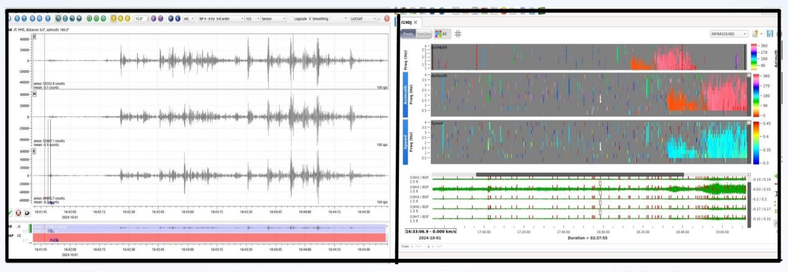


Figure 6. Left: Seismic record by Alkarama station (JSO). Right: Infrasound record I19DJ.

A Proposed Location for Portable Infrasound Station

The proposed location for the portable infrasound station is in northern Jordan, northwest of Jerash in Wadi Al-Sham Forests. The area has oak trees, low wind speeds, low noise levels, and it is governmental-protected, making it an ideal site (Figure 7).

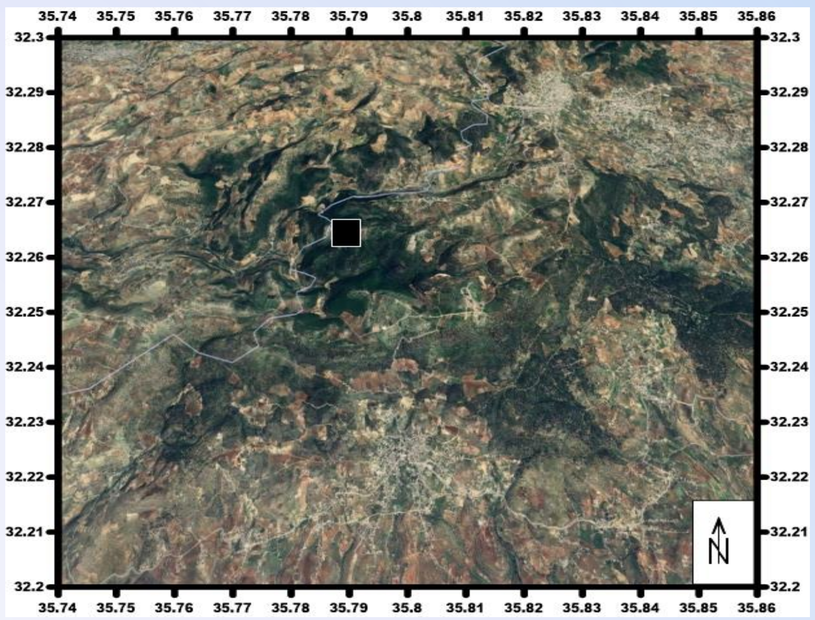


Figure 7. The proposed location for the portable infrasound station

Table 2 shows the main characteristics of the proposed area for the portable infrasound station

Table 2: Main characteristics of the proposed area for the portable infrasound station, Wadi Al-Sham Forests

Latitude	**32.245468°**
Longtude	35.771160°
Elevation	945
Structure:	There are secondary inactive faults that are not related to the main fault (Dead Sea Transform/DST) responsible for seismic activity in Jordan
Climate	• The climate is moderate • average Summer temperature (32-34°C) and at night (20-22°C) • average Winter temperature (6-14°C) whit average rainfall(220-230 mm) per year and the humidity (38%-62%)
Wind Speed	Average is (10.665) km/h(Gentle-medium wind) • Jan-June (10.5-12) km/h • July (12.5) km/h • Aug (12) km/h Sep-Dec (9.7 -11) km/h
Noise	The area is quiet and isolated, there are no mines, and it is away from human noise such as airports, highways, and industrial areas.
distance to road	250m

Conclusion

In Jordan, the main resources of infrasound waves either natural (earthquakes occur along the Dead Fault Transform (DSTF) or artificial (quarries that use explosive materials and explosions resulting from conflicts in the surrounding area).

The infrasound analysis particularly is important in identifying sources and monitoring the hazard.

The need to create an infrasound station in Jordan comes from the fact of necessity to detect all events accurately that have not detected before by the seismic stations. The result shows there is an area in Northwest of Jerash- Wadi Al-sham Forests is suitable to construct the proposed portable infrasound station.

The resulted data will be a great interest in International Monitoring System database (IMS). With the completion of the IMS Infrasound network in the near future, coupled with the introduction of a capacity building project in infrasound technology and learning physics of infrasound propagation and ways to use existing databases and software for its processing.

References

1. CTBTO Comprehensive Nuclear-Test-Ban Treaty Organization
2. JSO: Jordan Seismological Observatory
3. Mutschlecner J., Whitaker R., (2010): *Some atmospheric effects on infrasound signal amplitudes*, Infrasound Monitoring for Atmospheric Studies, 449–468 (2010).