Design and assembly of a low-cost experimental infrasound array for seismo-volcanic monitoring

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#168

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ABSTRACT

A seismo-volcanic crisis on Terceira Island led us to design and build a mobile low-cost experimental array, based on our previous experience of a successful collaborative deployment of an infrasound array from the University of Florence (UNIFI) on São Jorge Island, in April 2022.

We present the details of the design, the hardware and the assembly of a 6-element low-cost experimental array, deployed in April 2024 and designated as TER. This includes the data acquisition, which comprises the digitizer, the 4G mobile network router, the signal conditioning circuit and their respective interconnectivity, the six boxes with differential pressure sensors, and an innovative mechanical Wind Noise Reduction System (WNRS).

The communication between the sensors and the data acquisition box is assured by six 100-meter-long protected electrical cables. The energy for the array is supplied by a system of batteries coupled with solar panels.

The deployment took two working days, including site clearance, testing and adjustments in a densely forested area.

Keywords: Infrasound, Portable Array, North-Atlantic, Azores.

Concept

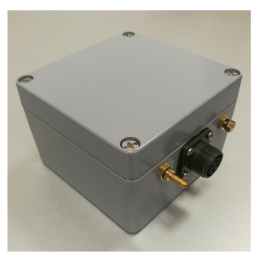
Design and assembly of an experimental robust infrasound array with available low-cost components, that can be quickly deployed in the vicinity of an active volcano for periods from months to years. The array must have simultaneously the sensitivity to detect very low and high-pressure sources that can occur on quiescent volcanoes, during periods of unrest and eventually of eruptive activity.

Components used

1


1. 24 bit 6-channel digitizer (1 unit)

- SARA SL06C6

2


2. Differential pressure sensor with 800 mV/Pa sensitivity - 25 Pa Vpp (5 units)

- Integrated Technologies for Environment Monitoring, ITEM.srl, mod.Prs0025

3

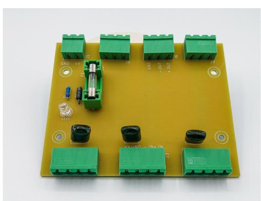

3. Differential pressure sensor with 25 mV/Pa sensitivity - 100 Pa Vpp (1 unit)

- Integrated Technologies for Environment Monitoring, ITEM.srl, mod.Prs0100a

4


4. 4G LTE Router (Dual Ethernet) and antenna for GSM transmission (1 unit)

- Sierra Wireless AirLink® LX60

5


5. Signal conditioner circuit PCB (2 units)

- Produced by Eurocircuit. Designed and assembled at IVAR's infrasound lab

6


6. Experimental WNRS (6 units)

- LabKit 700x7 mm silicone tubes + Opopark tea filters

7


7. Robust box for the array field acquisition system (1 unit)

- Mark MCS 1468

8


8. Robust box for the array field sensors (6 units)

- Mark MCS 1233

9


9. Solar panel with locally made support (2 units)

- Victron Energy Bluesolar 175 W 12 V

10


10. Batteries (2 units)

- BOSCH S513 12 V-100 Ah

11


11. 12-24 V Solar charge controller (1 unit)

- PWM YJSS60 RPS60A/12-24USB

12


12. Copper wiring for signal intrasite communication (6x100 m)

- POLISCREEN® LiYCY (TP) Eca

13

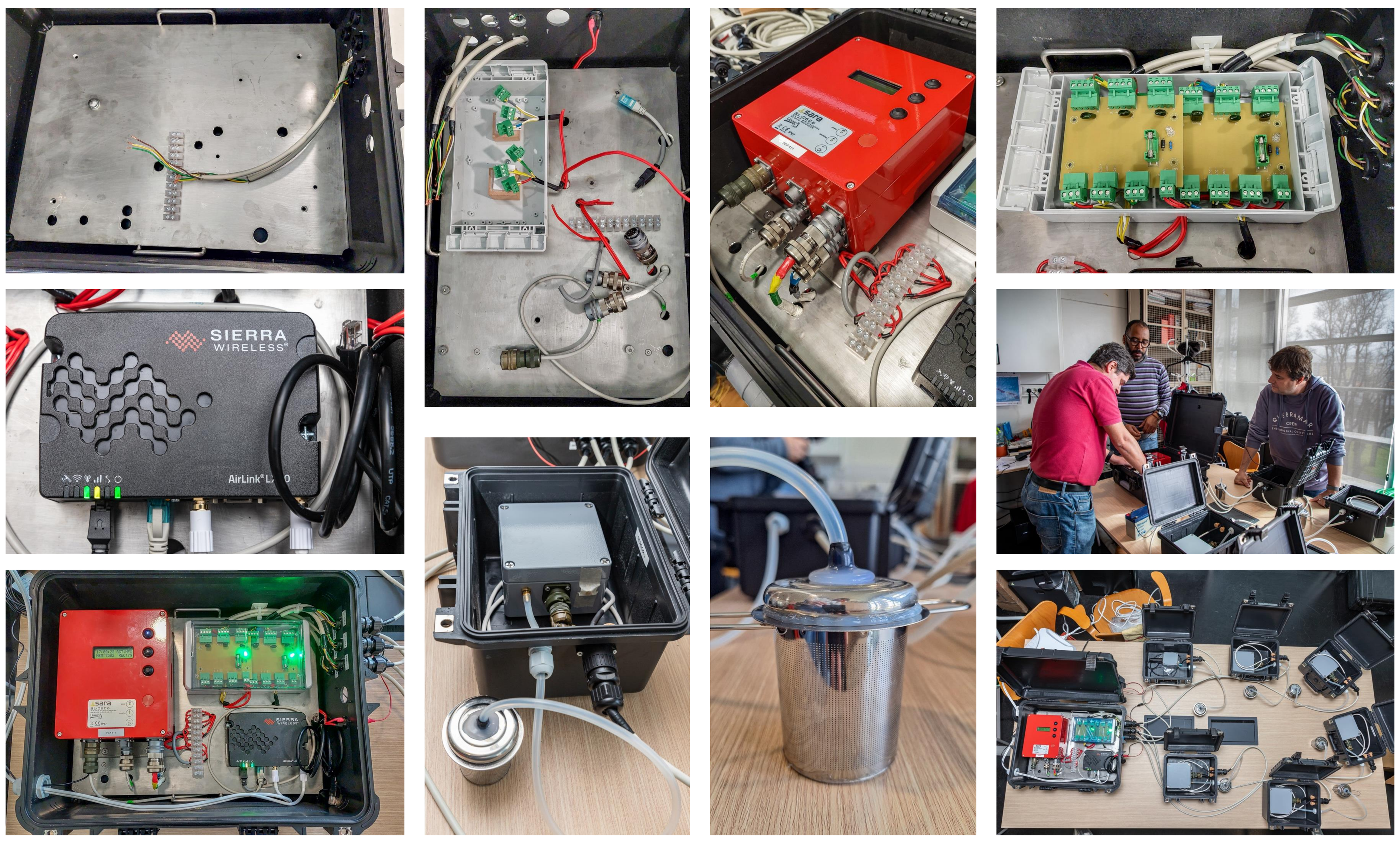

13. 25 mm Protection plastic tube (13x50 m)

14. Metal plate, plastic box, wiring, plugs, copper ground stick, etc.

Assembly

Equipment, parts and consumables were supplied by international, national and local companies. All the components were adapted and assembled at the infrasound lab of IVAR, with limited tools available.

The main objective was to build a robust system, almost plug-and-play to deploy in the field, to face the frequent heavy storms of the North Atlantic Islands. The following images illustrate the main steps of the array assembly.



Field deployment

The site selection, the array geometry and deployment are described by Silva *et al.* (poster #124, this workshop). Due to hardware limitations the acquisition and batteries boxes must be installed on the southern side of the forested area, to guarantee good sun exposure of the solar panels, at a distance from the forest border limited by the extension of the GPS and 4G antennas cables (10 metres). Each of the intrasite communication cables are 100-metres long, which is the limit for energy transport, to guarantee a good flexibility in the array geometry. They are protected by a hard, corrugated plastic tube to prevent damage from rodents. The following images illustrate the array field deployment.

CONCLUSIONS

A seismo-volcanic crisis in Terceira Island, centred in Santa Bárbara Volcano, was the trigger to advance with the project to design, build and deploy an experimental low-cost infrasound array, based in our previous collaborative experience with colleagues from the University of Florence (UNIFI) in São Jorge Island (Jesus *et al.*, 2024). With a total cost of ~20k €, the new array achieved the proposed goals, recording good infrasound data (see Poster #124, this workshop), although there are still some testing and improvements to be performed.

ACKNOWLEDGEMENTS

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REFERENCES

Jesus, M.C., Belli, G., Gheri, D., Matos, S., Wallenstein, N. & Marchetti, E. (2024) - The use of a low-cost, small-aperture array as an auxiliary tool to improve infrasound monitoring in the Azores region. *Pure and Applied Geophysics*, doi:10.21203/rs.3.rs-3442956/v1.