SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Infrasonic and seismic source characterisation of an unknown sonic boom in the Tyrrhenian Sea

G. Belli[1], D. Gheri[2], A. Fiaschi[3], E. Marchetti[1], N. Galfo[3]

[1]University of Florence, Florence, Italy
[2]Istituto Nazionale Geofisica e Vulcanologia (INGV), Pisa, Italy
[3]Istituto Geofisico Toscano, Fondazione Parsec Prato, Italy

INTRODUCTION AND MAIN RESULTS

In this work we analyse the infrasonic and seismic signals produced by a powerful sonic boom heard on the Tyrrhenian Sea area on 20 June 2024.

We use both infrasonic and seismic data to locate the source obtaining a good match with the two localisation methods.

Reconstructed source position, recorded waveforms and event energy are consistent with a fireball, crossing the atmosphere and exploding over the Tyrrhenian Sea.

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Introduction

On 20 June 2024 a powerful sonic boom shook the inhabitants of Elba Island (Tuscany, Italy) and was heard in a huge area on the coast of Tuscany and Corsica. The event was not associated to any observed phenomenon, so that its nature remained initially unclear.

The event generated infrasonic and seismic signals which were recorded by two infrasonic arrays deployed in Elba Island (ELB) and on Mount Amiata (AMT, southern Tuscany) (Figure 1) and by 14 seismic stations located throughout Tuscany (Figure 2).

Recorded infrasonic and seismic signals are analyzed to investigate the source.

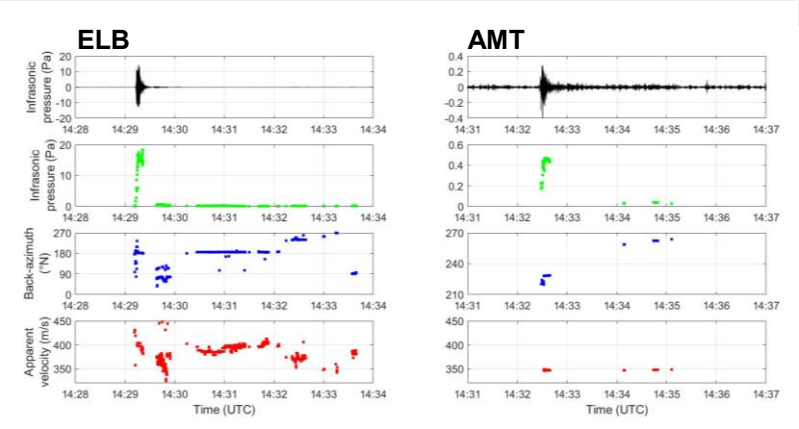

Figure 1: array processing of infrasound data recorded at ELB (left) and AMT (right); computed pressure (green), back-azimuth (blue) end apparent velocity (red) of the infrasonic detections.

Analysis and Results: Source Localisation

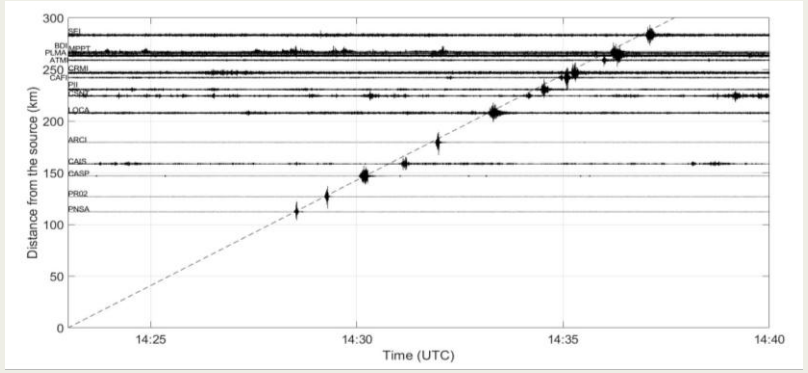

Figure 2: normalized seismic tracks recorded at the 14 stations in Tuscany.

Array processing is performed on data recorded at ELB and AMT arrays to characterize the signals in terms of back-azimuth and apparent velocity (Figure 1).

Infrasonic 3D ray tracing from both stations is then applied to reconstruct the ray paths, locate the source and reconstruct the occurrence time.

We use the "–prop" mode of InfraGA using the back-azimuth and apparent velocity of recorded infrasound and local weather data up to 150 km altitude (on a grid of 0.25°, using the NCPA G2S tool). The source position is then determined as the intersection point of the rays reconstructed for the two arrays, pointing at ~40 km South of Montecristo Island at ~65 km altitude (Figure 3a), with an occurrence time equal to 14:23:39.

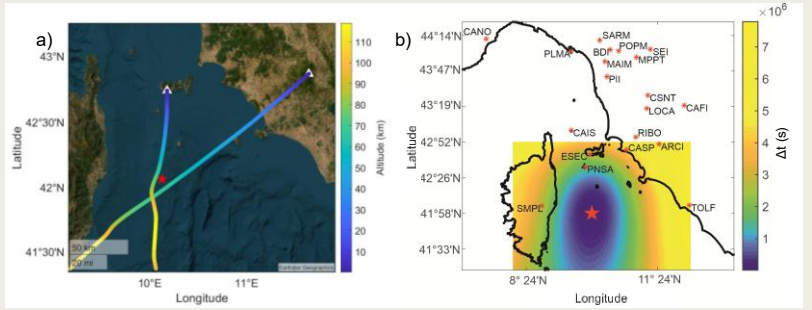

Figure 3: source position (red star) reconstructed with infrasound (a) and seismic (b) data.

The obtained source position is in good agreement with the localisation computed analyzing the arrival times at the 14 seismic stations and assuming an isotropic constant wave propagation velocity of 330 m/s (Figure 3b), leading to a source position ~40 km south of Montecristo at 75 km altitude.

Discussion and Conclusions

Based on the reconstructed source position, as well as on the waveform and the high amplitude of the recorded seismo-acoustic signals, we interpret the sonic boom as the result of a fireball event, crossing the atmosphere and exploding over the Tyrrhenian Sea.

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