University of Brasilia studies explosions occurred in Beirut - Lebanon

The Seismological Observatory (SIS) of the University of Brasília (UnB) located the explosion occurred in Beirut, today, 8/4/2020, at 15:10:42 (UTC), 12:10:42 (Brasília time) and 18:10:42 (local time), using data from three infrasound stations of the International Monitoring System (IMS) network.

SIS - UnB collaborates with a United Nations Organization (CTBTO – Comprehensive Nuclear-Test-Ban-Treat Organization), based in Vienna - Austria, which aims to verify compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Brazil participates in this organization with data from its stations and with information gotten from the analysis and interpretation of data from the IMS Network with 321 geophysical sensors, which covers the entire planet. Any nuclear explosion, whether underground, underwater, or in the atmosphere, with a power equivalent to at least 1 kiloton of TNT (Trinitrotoluene - explosive material), can be detected by this network.

SIS - UnB operates stations with two technologies of this network located in Brasília: a seismic (suitable for detecting underground nuclear explosions) and infrasound (suitable for detecting atmospheric nuclear explosions). Due to distance (10000 km) and energy liberated, the Beirut explosion was not recorded by these stations in Brasília. However, three infrasound stations, belonging to this worldwide monitoring network (IMS), to whose data the SIS - UnB has access, located in Germany (code I26DE, 2500 km from Beirut), Tunisia (I48TN, 2400 km from Beirut) and Côte d'Ivoire (I17CI, 5000 km from Beirut), registered this event, figures 1, 2 and 3, respectively.

The yellow star in Figure 4 shows the location of the explosion in Beirut. The azimuth rays of each station point to the source of infrasound waves. Despite the distances from the stations, the orientation calculated in the interactive data processing obtained a satisfactory result. This analysis, performed with only three infrasound stations, can be improved using data from seismic stations as well.

This explosion was recorded by infrasonic stations so far away due to the charge of the explosive (the USGS -United States Geological Survey, the estimated magnitude

of 3.3 on the Richter Scale). The wind propagation direction, which helps in the propagation of the infrasound waves over great distances, stations on the east side did not register this event. The energy released by the explosion was greater than that one liberated by a magnitude 3.3 earthquake because while an earthquake occurs underground it has most of its energy converted into seismic waves, this explosion was superficial and, therefore, no all energy has been transformed into seismic waves, the amplitude of which gives a measure of its magnitude.

If an underground nuclear explosion, with a power of 1kt (15 times less than the Hiroshima bomb), releases energy equivalent to that of a magnitude 4 earthquake, then that explosion in Beirut may have released the energy of about 0.3 kilotons (preliminary calculations).

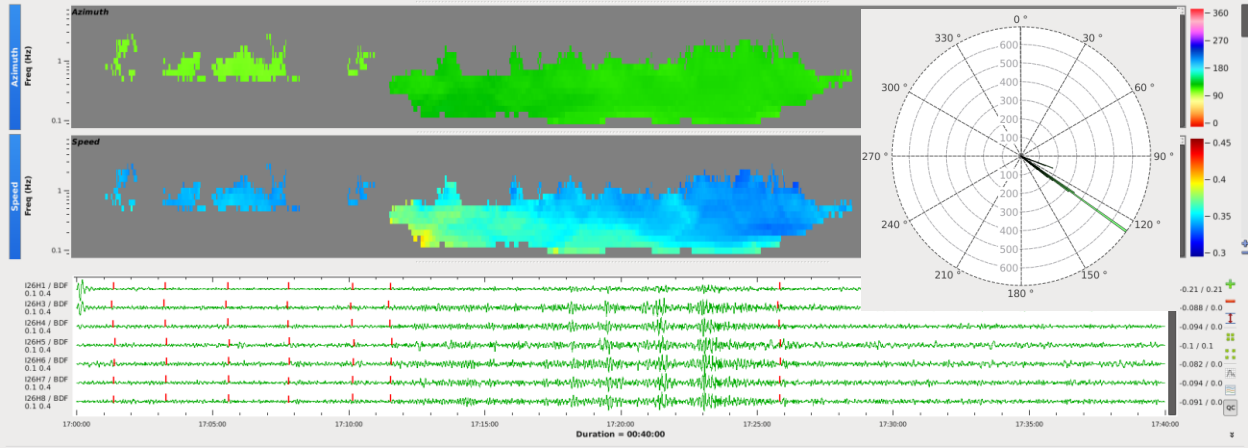

Figure 1: Register of the Beirut explosion at an infrasound station located in Germany (I26DE), about 2500 km away from Beirut. At the top, an indication of the back azimuth of the infrasonic waves fronts arriving at the station (average = 125 degrees). In the center, the indication of the infrasound waves velocity propagation (average = 346 m/s). At the bottom, infrasound signals registered in the 8 elements of the I26DE Station. On the right, the rosette diagram, indicating the direction of the wave front that arrives at the station (125 degrees).

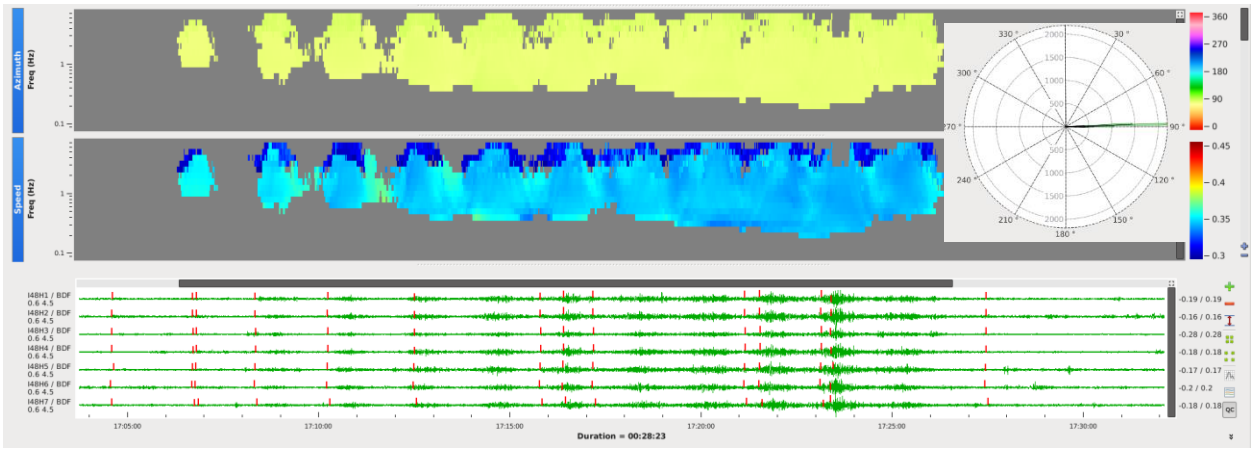

Figure 2: Register of the Beirut explosion at an infrasound station, located in Tunisia (I48TN about 2400 km from Beirut). In the upper part, the indication of the azimuth of the infrasound waves fronts arriving at the station (average = 88.6 degrees). In the center, the indication of the infrasound velocity propagation (average = 348 m / s). At the bottom, infrasound signals at the 7 elements of the I48TN Station. On the right, the rosette diagram, indicating the direction of the wave's front direction that arrives at the station (88.6 degrees).

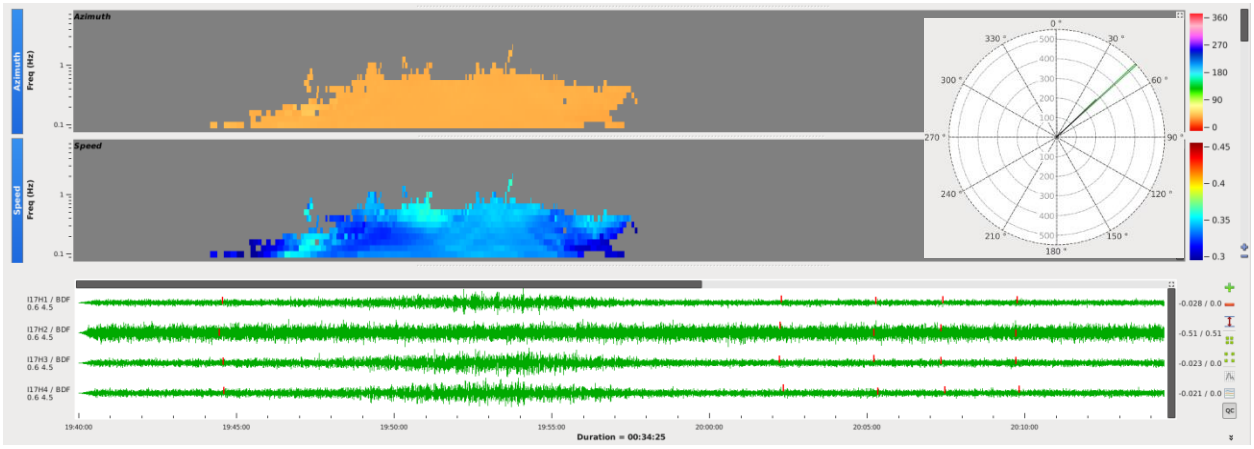

Figure 3: Register of the explosion at an infrasonic station located in d'Ivoire (I48TN), about 5000 km away from Beirut. At the top, an indication of the back azimuth of the infrasonic waves fronts arriving at the station (average = 47.2 degrees). In the center, the indication of the infrasound waves velocity propagation (average = 348 m/s). At the bottom, infrasound signals recorded in the 8 elements of the I17CI Station. On the right, the rosette diagram, indicating the direction of the wave front that arrives at the station (47.2 degrees).

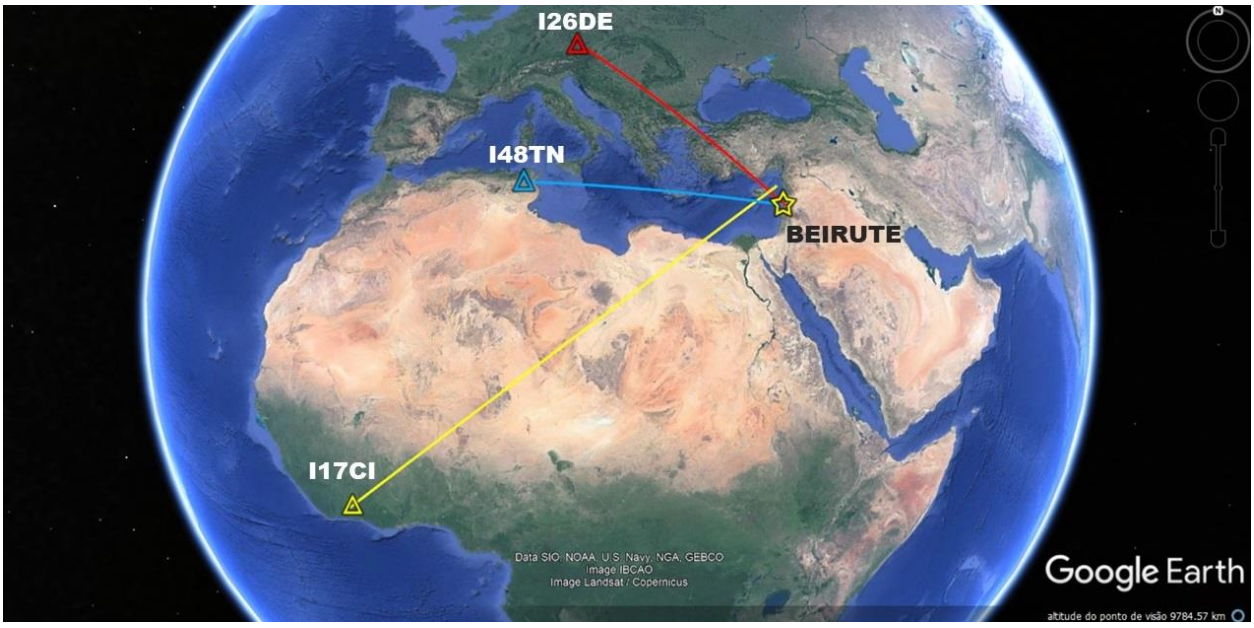

Figure 4: Location of the explosion in Beirut, from 4/8/2020, at 15:10:42 (UTC), 12:10:42 (Brasília time) and 18:10:42 (local time). The triangles indicate the infrasound stations and the yellow star indicates the location of the source (Beirut). Azimuth rays from Station I26DE, located in Germany, Station I48TN, located in Tunisia and Station I17CI, located in Côte d'Ivoire, point in the direction of the source.

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