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Skyquakes phenomenon analysis using geophysical approach in Java Island

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ABSTRACT

Explosions in the sky (Skyquake) like an earthquake are still mysterious. The main purpose of this research is to to provide an overview of the source of the explosion that occurred with a geophysical approach, based on both earthquakes, thunderstorms and earth magnets. In this case, we used the geophysical approach to evaluate and analysis the skyquakes based on the spectral density and magnetic field. The result indicates that the earthquake sequences that occurred simultaneously were not related to crash events at different times, 11 April 2020 and May 11, 2020, as well as the electrical activity of the air and the earth's magnet, the assumption of the 11 April 2020 explosion originating from lightning and magnetic activity is still very weak.

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1. INTRODUCTION

Explosions in the sky (Skyquake) like an earthquake are still mysterious. A sonic boom or cannon fire will give a good idea of what an earthquake might sound like, a very loud sound, the sound of rattling windows. While a sonic boom is caused by an object breaking the sound barrier, an earthquake is when an explosion occurs for no apparent reason. Whether the skyquake is real or not remains a very interesting object to research.

Based on the results of previous studies and reports, this skyquake phenomenon has occurred in several countries including the Ganges river in India, the East Coast and Finger Lake of the United States, the North Sea of Japan, the Bay of Fundy in Canada, and parts of Australia, Belgium, Scotland, Italy and Ireland. [1]. The naming of the skyquake also depends on the naming at the scene. As in Bangladesh, it is called "Barisal gun" (referring to the Barisal region in East Bengal), in Italy it has several names for skyquakes, including "balza" "brontidi" "lagoni" and "marine", in Japan the sound is known as "umimari. "(crying from the sea), in Belgium and the Netherlands, skyquakes are called" mistpoeffers ", in Iran and the Philippines, are called" retumbos "in the United States, some skyquakes are called" Seneca gun "(near Seneca Lake, New York) and" Moodus noise "in Connecticut [1].

The skyquake phenomenon is an event that needs to be studied based on the causes of the incident. Most scientists propose another possible explanation for this phenomenon, the cause of the

skyquakes may be a sonic boom from a meteor or military aircraft [2]. Earthquakes and volcanic ruptions can produce sounds (skyquakes) that are heard far from their point of origin. A well-documented report on explosive sounds associated with earthquakes, particularly those from shallow earthquakes [3].

The cause of skyquakes can also come from distant thunder, with sound focused by the atmosphere and can be caused by bright sky lightning ("bolts of blue"). that occurs near mountain ranges or large open areas, such as plains, sounds, or lakes [1].

Multiple skyquakes can be generated by coronal mass ejections (CME). CME is a solar radiation storm that can accelerate protons up to 40 percent of the speed of light, potentially producing shock waves that break the speed of sound and produce sonic booms. [4]. Other studies have also suggested that skyquakes can be generated from Earth's magnetic field by accelerating particles or from resonance [5].

In Indonesia, the skyquakes incident occurred in April and May 2020, based on sources obtained from several reports, skyquakes or what is known as the explosion occurred in West Java and Jakarta 11 April 2020 [6], [7] and Central Jawah 11 May 2020 [8]. In this study, an analysis was carried out on the source of the boom that occurred in Indonesia. The purpose of this study is to provide an overview of the source of the explosion that occurred with a geophysical approach, based on both earthquakes, thunderstorms and earth magnets.

2. RESEARCH METHOD

In this study we used the geophysical approach to evaluate and analysis the skyquakes based on the spectral density and magnetic field. The approach taken in this study is to compare the data collected in the BMKG, especially in the Geophysics deputian and the reference sources discussed earlier. BMKG according to Law No. 31 of 2009 has the duty and function to provide information on earthquakes, air electricity and Earth magnets [9]. In this case, the data used in answering the boom phenomenon is divided into three important parts, namely based on studies of earthquakes, air electricity and Earth magnets.

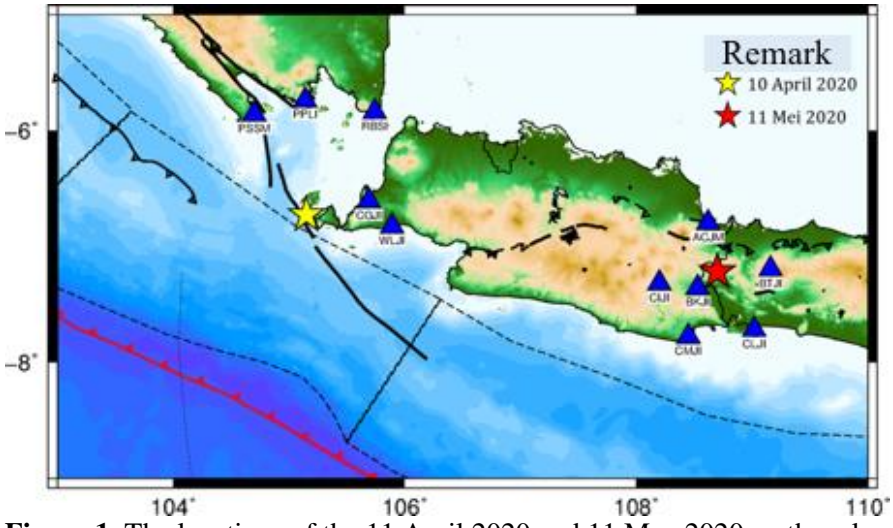

Figure 1. The locations of the 11 April 2020 and 11 May 2020 earthquakes

Based on earthquake data, 1 event was recorded on 10 April 2020 and 1 event on 11 May 2020 (Table 1), or it can be seen visually in Figure 1.

Table 1. Earthquake events April 10, 2020 and May 11, 2020

Origin Time	Mag.	Lat.	Long.	Depth	Region
2020-04-10T22:59:44 WIB	2.8	-6.73	105.15	13.8	Sunda Strait, Indonesia
2020-05-11T00:06:48 WIB	2.7	-7.22	108.70	10.0	Java, Indonesia

In Figure 1, an earthquake occurred in Sunda Strait, Indonesia, on April 10, 2020 and an earthquake event was also recorded on May 11, 2020 in Central Java.

3. RESULTS AND DISCUSSION

In theory, described by [3], the source of the boom (skyquakes) can be from an earthquake. Other researchers [10] also conducted a study of skyquakes, one of the detection techniques in searching for skyquakes is the seismic network. During the 11 April 2020 and 11 May 2020 crash events, the people in West Java, Jakarta and parts of Central Java felt at different times. This phenomenon is an interesting thing to study.

In the initial study, the boom phenomenon was based on a seismic network detection approach [10] which can be done as an alternative in finding the source of the boom in Indonesia. The results of earthquake activity on the same day in the incident area illustrate that the impact did not originate from earthquake activity. This is shown from the results of seismic monitoring which recorded earthquake activity that occurred with a magnitude of 2.8, at 70 km south-west of Mount Anak Krakatau at a depth of 13.8 km, and a magnitude of 2.7 at a depth of 10 km in Central Java as shown by Figure 2. This earthquake is not related to the sound of the early morning boom on April 11 2020 and May 11 2020, because the spectrum energy levels shown in Figures 2a and 2b are very small and very local in nature.

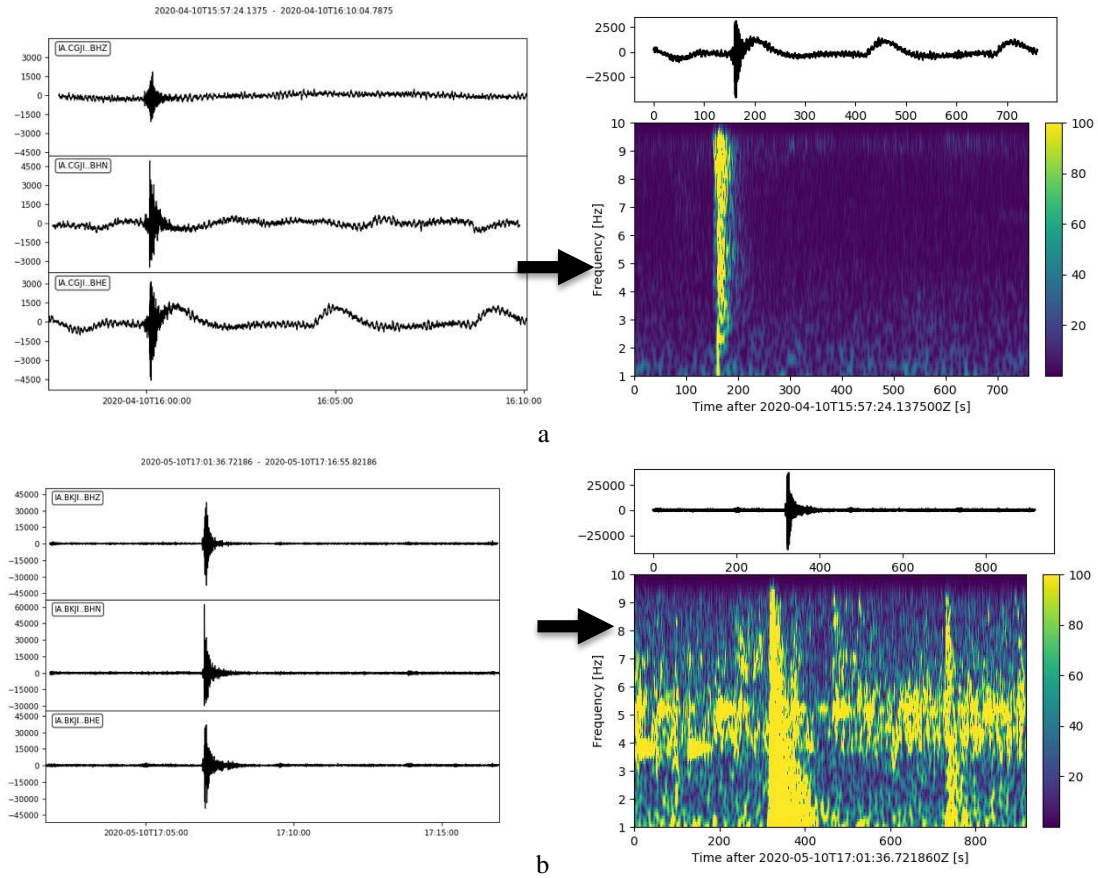

Figure 2. Earthquake activity signal: a. 10 April 2020, b. 11 May 2020

The next study was carried out with the approach of air electricity and earth magnetism. Based on the results of potential geophysical reports [11], The analysis is done by looking at the electric potential of the air and the earth's magnetic activity.

Air electricity data in Figure 3 shows a map of the density of lightning events / km2 of lightning occurring at 02.00 - 03.00 WIB in the border areas of Bagor and Banten, Java and Palembang seas. The lightning density is quite wide, namely in the border area of Bogor and Lebak, with a large enough diameter of about 38 km to the west-east.

Public report resultst [6], shown that the assumption of the source of the explosion originating from a lightning event is not basic and very weak, because based on the lightning distribution in Figure 3, the normative range of lightning is around 10 miles [12], [13], while from public reports the source of the boom was heard and scattered in several different areas, namely Tangerang, Jakarta, Bogor, Bekasi and Sukabumi with an area of around 100 Km^2.

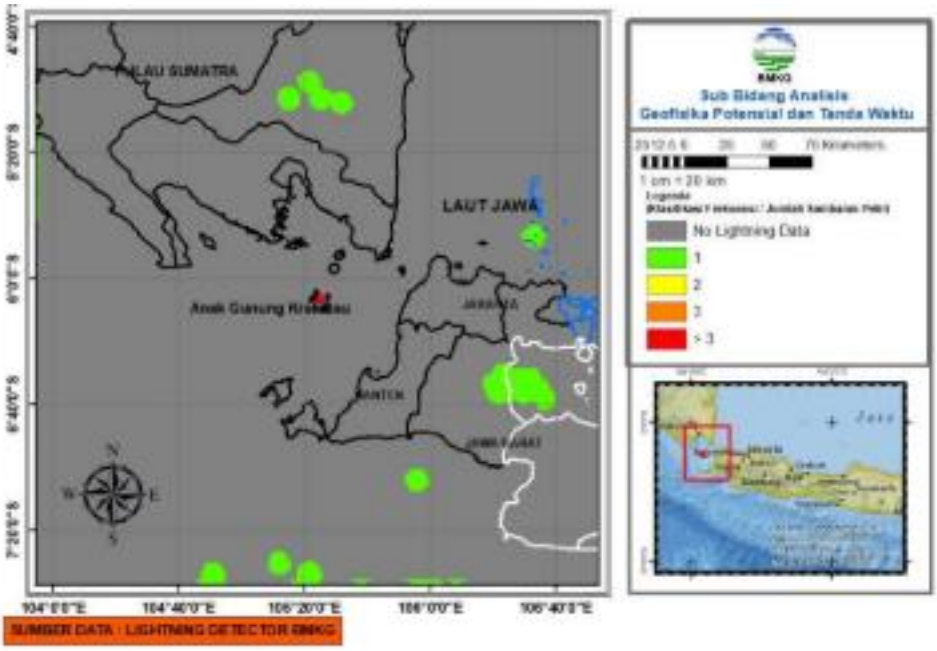

Figure 3. Lightning Event Density [11]

The next study is that the source of the explosion can be observed using the magnetic earth activity approach. Observation results [14] explained that the skyquake could result from geo-magnetic activity. The results of studies that have been carried out by potential geophysics based on the earth's magnetism [11], Using global Earth magnet data, the Dst (Disturbence Storm Time) Index describes the magnetic activity at low latitudes (Low Latitude). Geographically, Indonesia is included in the low latitude zone to be precise in the Equator region, so using the Dst Index data it is sufficient to represent the global activity of the earth's magnet at low latitudes. The Dst Index has a Classification for> - 20 nT is a quiet day or Quite Day and <-20 nT is a magnetic storm with various levels from weak to strong. Figure 4 shows the Etc. Index from April 1 - 12, 2020, the red box is the index activity etc. on April 10, 2020 which shows that date is Quite Day / Quiet Day (> - 20 nT).

The findings of the investigation of data from 2 BMKG earth magnetic network stations closest to the location of the community who reported hearing the booms. In this condition, it was found an interesting phenomenon that the impact was recorded well at the earth magnet stations in Sukabumi (SKB) and Lampung Selatan (LPS) which is shown in Figure 5 which shows a Bandpass filter of 0.03 - 0.1 Hz. This signal shows a recording of magnetic anolami activity in the Horizontal (H) component at 01.45 - 02.45 WIB or 18.45 - 19.45 UT which is shown by the Green box line.

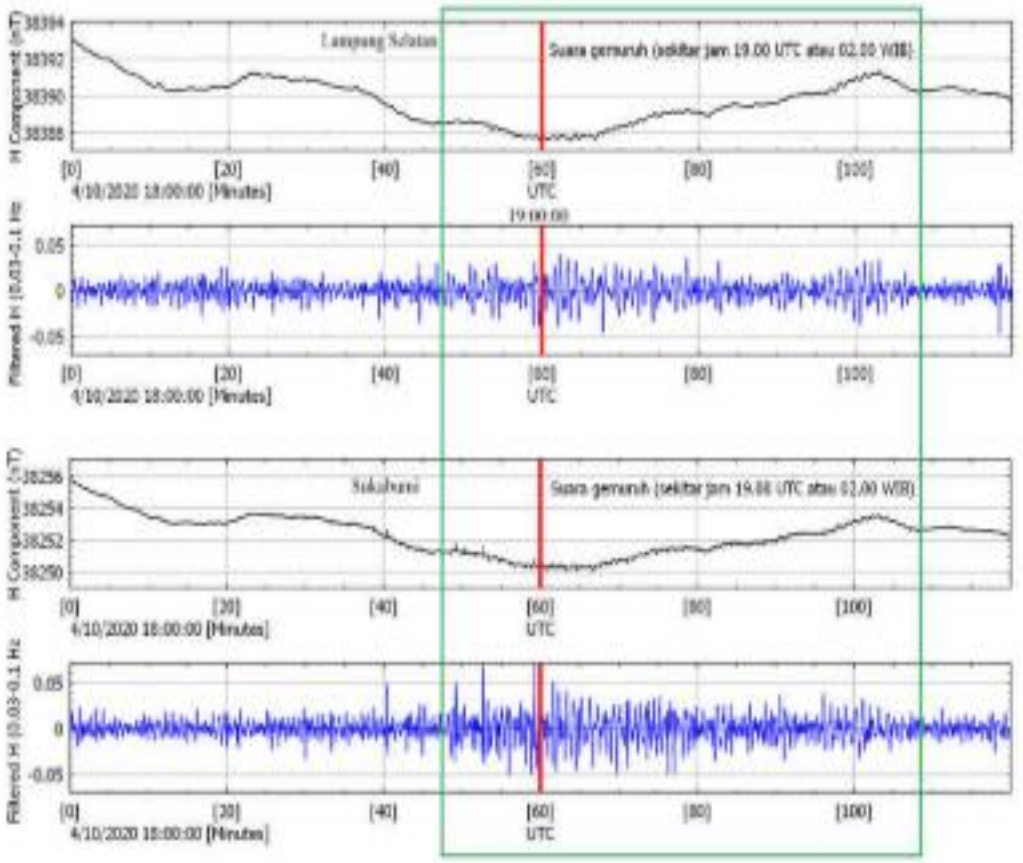

Figure 4. Original signal (Black) and Bandpass filter 0.03 - 0.5 Hz (Blue) on the Horizontal Components recorded at the Earth Magnet Station in South Lampung (LPS) and Sukabumi (SKB) which shows an increase in signal for 1 hour, namely at 18.45 -19.45 UT / 01.45 -0.45 wib) in a Green box [11]

From these findings we carried out further analysis of the BMKG geomagnetic data spread across Indonesia plus geomagnetic tools abroad. This is done to see in more detail whether the boom phenomenon is local, regional or global in nature. From this analysis, it is obtained that magnetic field anomalies are recorded at the same time on the network of the BMKG earth magnetic station, but are not recorded on the network of earth magnetic stations in Canberra (Australia) and Kakioka (Japan) (See Figure 3). The maximum amplitude Z / H ratio analysis occurred at 02:08:30 WIB or 19:08:30 UT recorded not only in South Lampung (LPS) and Sukabumi (SKB) but also all BMKG earth magnetic stations represented by 14 stations namely Sabang (SBG), Meulaboh (MLB), Simalungun (SMG), Sic Cincin (SCN), Muarajambi (MJB), Kepahiyang (KPY), Cilacap (CLP), Yogya (YOG), North Lombok (LTU), Gorontalo Palu (PLU), Luwuk (LWK) and Gorotalo (GTO).

In general, the occurrence of the boom phenomenon that occurred in Indonesia can be categorized as a mysterious phenomenon whose source still needs to be studied, based on the results of studies that have been carried out, either by using earthquake data, air electricity and magnetic activity in the vicinity of the incident area, no correlation was found. positive about the phenomenon of skyquakes. Based on [15] which is stated in a book entitled "Weird Weather, Tales of Astronomical and Atmospheric Anomalies" skyquakes are still a phenomenon that needs to be studied based on their source, there is no real explanation, that it must be "earthquake", "sonic boom", or magnetic activity.

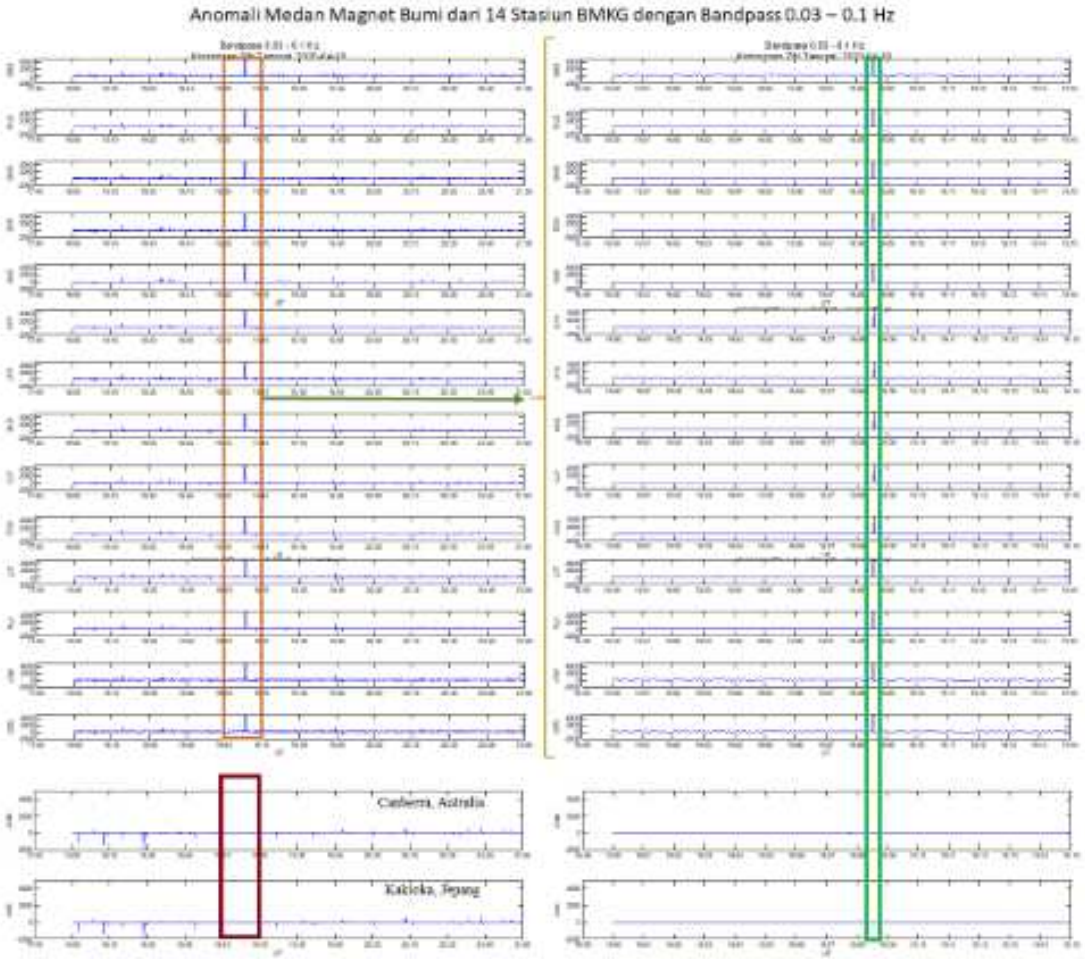

Figure 5. Bandpass Ratio Comp. Z / H at a frequency of 0.03 -0.1 Hz for 14 stations in the territory of Indonesia that record the Maximum Amplitude and 2 stations outside Indonesia namely Canberra, Autralia and Kakioka Japan do not record those aimed at the Green Box [11].

4. CONCLUSION

Based on the analysis of the source of the earthquake, air electricity and the earth's magnetism, it can be concluded that the skyquakes do not originate from earthquake activity, air electricity or earth magnetism. Earthquakes, air electricity and earth magnetism were not related to the impact phenomenon that occurred in this phenomenon, both those that occurred on April 11, 2020 and May 11, 2020. The earthquake sequences that occurred simultaneously were not related to crash events at different times, 11 April 2020 and May 11, 2020, as well as the electrical activity of the air and the earth's magnet, the assumption of the 11 April 2020 explosion originating from lightning and magnetic activity is still very weak.

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