Space weather related to M6+ earthquakes recorded on June 24, 2019

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Abstract

On June 24, 2019 two potentially destructive seismic events were recorded in Indonesia (Indonesia M6.1 earthquake, recorded at 01:05:29 UTC; Indonesia M7.3 earthquake, recorded at 02:53:39 UTC). The analysis of the solar ion flux density allowed the authors to verify that the two earthquakes were preceded by a solar wind proton density increase and were recorded precisely in the hours in which this increase reached its maximum level (± 6 hours): this type of correlation was observed for the first time by the authors in 2011 and currently the solar wind proton density increases are considered the most reliable family of seismic precursors that has been identified by the scientific community.

Keywords: proton density increase, seismic precursors, solar activity, Indonesians earthquakes, seismic prevision.

Introduction

It has now been scientifically ascertained that the M6+ seismic activity recorded on our planet is always preceded by an increase in the density of the solar ion flux [3-16] [18-25] which later can also produce geomagnetic perturbations related to earthquakes [1-4] [9] [11-13] [15] [16] [18] [22-25]. In 2012 [1] the authors identified for the first time ever an electromagnetic seismic precursor of solar origin that always precedes potentially destructive earthquakes; this seismic precursor is represented by the increases in the density of the solar proton flux reaching our planet. In this work, the authors will present the results of the correlation study carried out between solar activity and M6+ global seismic activity recorded on June 24, 2019 (**Fig. 1**):

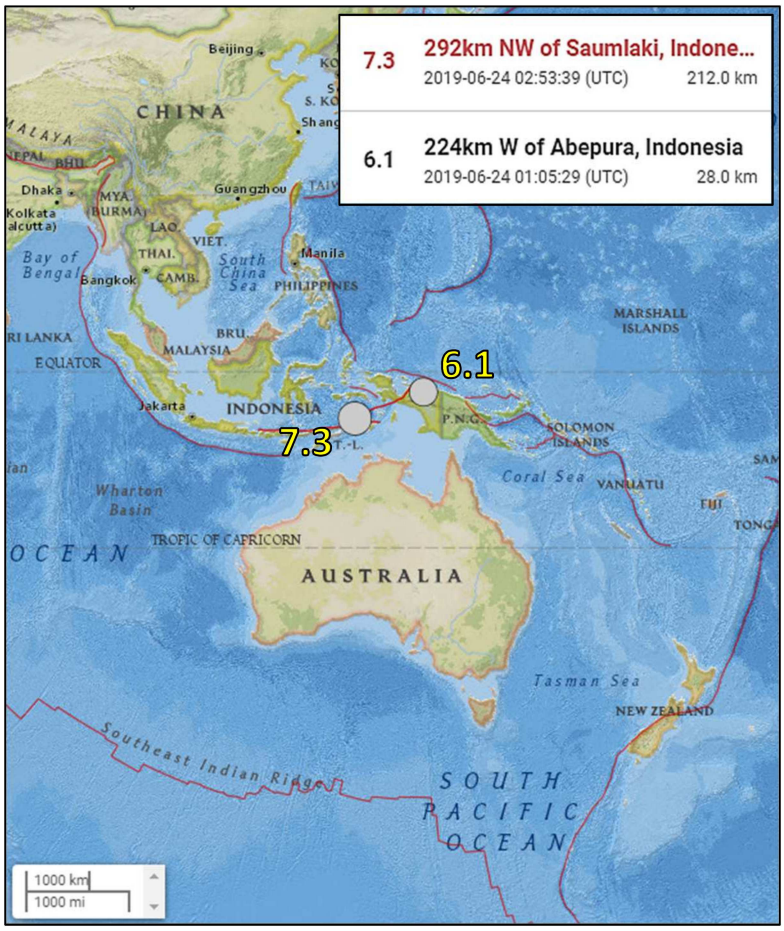

Fig. 1 – Seismic epicenter of M6+ earthquake recorded on June 24, 2019. The map above shows the seismic epicenter of the M6+ earthquake recorded on June 24, 2019. Credits: USGS, Radio Emissions Project.

1. Indonesia M6.1 earthquake, recorded at 01:05:29 UTC (28km depth);
2. Indonesia M7.3 earthquake, recorded at 02:53:39 UTC (212km depth).

Data analysis

Between June 23, 2019 at 13:20 UTC and June 24, 2019 at 14:00 UTC, the DSCOVR Satellite (located in Lagrangian orbit L1) detected a solar

wind proton density increase. During this time interval, the solar wind proton density increase has undergone three important oscillations reaching three peaks of maximum increase (**Fig. 2**):

1) 17.1 p/cm^3: recorded on June 23, 2019 at 23:50 UTC;

2) 17.6 p/cm^3: recorded on June 24, 2019 at 01:16 UTC;

3) 20.1 p/cm^3 (which represents the maximum peak): recorded on June 24, 2019 at 01:56 UTC.

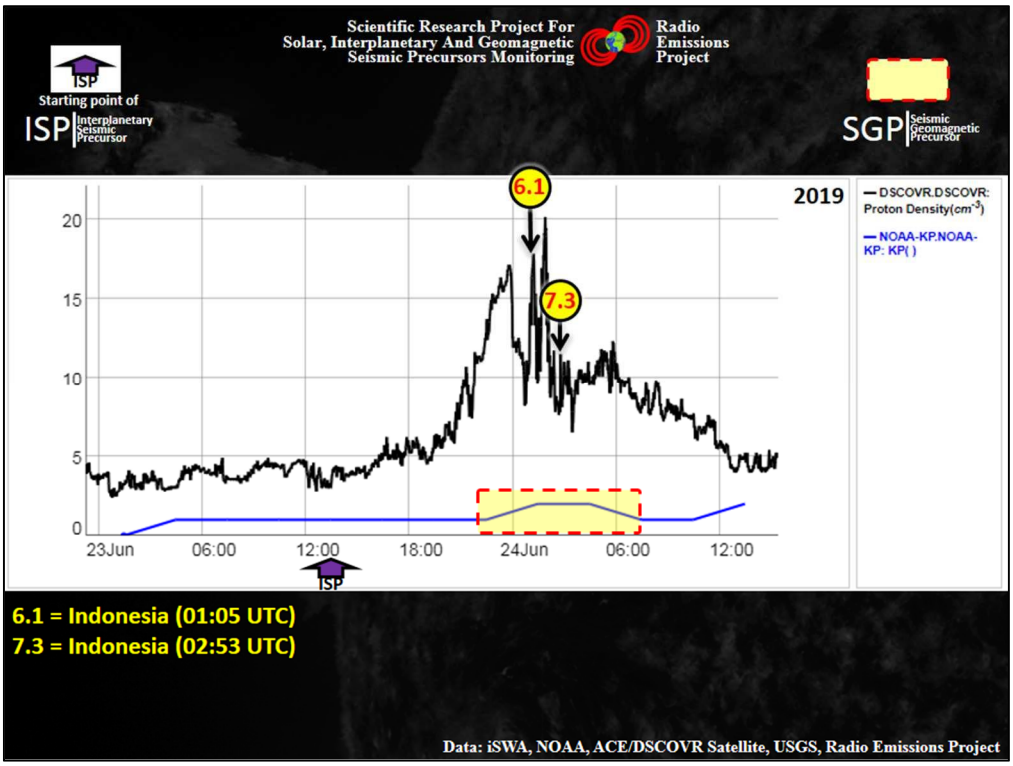

Fig. 2 – Variation in solar ion flux and Earth's geomagnetic activity related to the M6+ global seismic activity recorded on June 24, 2019. The graph above shows the time marker of Indonesia M6+ earthquakes recorded on June 24, 2019 (black vertical arrow). Analyzing the data in the graph it is evident that the Indonesian earthquakes was preceded by a solar wind proton density increase (Interplanetary Seismic Precursor; black curve) and by an increase of Kp Index (Seismic Geomagnetic Precursor; blue curve highlighted by the yellow area). The purple arrow indicates the start of solar wind proton density increase. Credits: iSWA, USGS, Radio Emissions Project.

The **Fig. 2** clearly shows the type of correlation that the authors observed between the variations of the solar ion flux and the M6+ global seismic activity. Since all M6+ seismic events that are recorded on a global scale are always preceded by an increase in the density of the solar proton flux, it is evident that a form of electromagnetic interaction must contribute to seismogenesis [18] [21] [22]: the M6.1 earthquake was recorded between the first and second density peak; the M7.3 earthquake was recorded after the third peak (which is also the biggest one compared to the other two).
on 24 June 2019, between 01:30 UTC and 04:30 UTC, an increase in the Kp Index was recorded which reached the level of "2": a certainly low level but always higher than the basal level (which in this case it corresponds to "1"). The Earth's geomagnetic activity is conditioned by the characteristics (speed, density, dynamic pressure, intensity of Interplanetary Magnetic Field or IMF) (**Fig. 3**) of the solar ion flux, in fact the shy increase observed in the graph is an effect caused by solar wind proton density increase that preceded the two M6+ seismic events.
To confirm what has just been stated, it is possible to observe the graph in **Fig. 3**: a perturbation of Interplanetary Magnetic Field (IMF) preceded the first Indonesian earthquake by at least 1 hour and the second Indonesian earthquake by almost 3 hours. Perturbations of Interplanetary Magnetic Field (IMF) are events caused by an increase in the density/velocity of the solar ion flux and, therefore, are also related to the M6+ seismic activity.

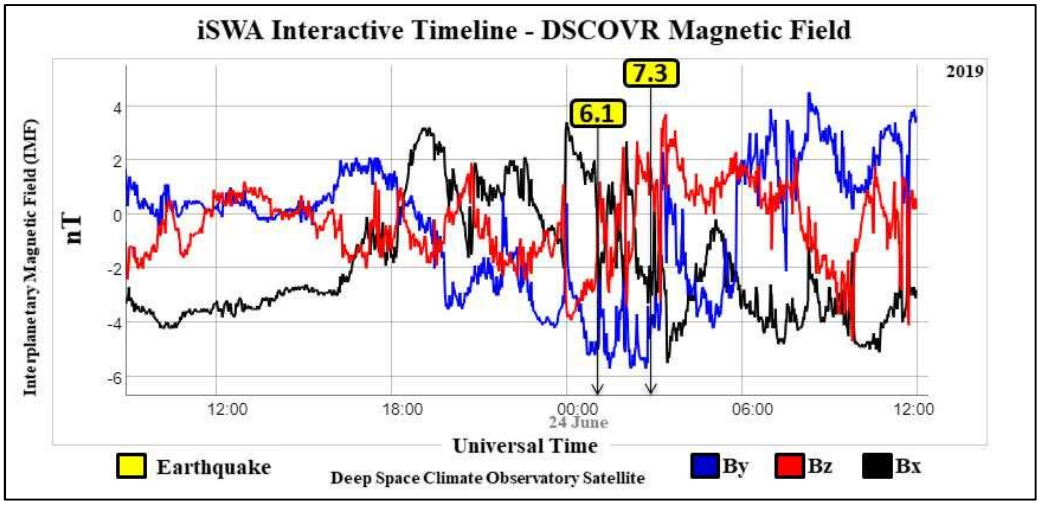

Fig. 3 – Solar wind magnetic field perturbation correlated to M6+ earthquakes recorded on June 24, 2019. The chart above shows the variation of the interplanetary magnetic field (IMF) recorded through the Deep Space Climate Observatory (DSCOVR) Satellite in orbit at L1 Lagrange point. The recording was done on 3 axes (By, Bx, Bz). Analyzing the variation curves it is evident that the two M6+ earthquakes recorded in Indonesia has been preceded by a perturbation of the interplanetary magnetic field (IMF) whose greater intensity was recorded between 00:00 UTC and 18:00 UTC of June 24, 2019. The long black vertical arrow represents the temporal markers of M6+ earthquakes. Credits: iSWA, USGS, Radio Emissions Project.

Conclusions

The M6+ seismic activity is always correlated (preceded) to an increase in the density of the solar ion flux. The monitoring of solar activity, therefore, is a very important activity in the context of seismic forecasting. The authors have identified this type of correlation since 2011: the first large-scale study was carried out starting from January 1, 2012 [1] and is still ongoing. Currently, through the data obtained from this study, the authors have managed to create a new seismic forecasting method that is able to establish (with notice of about 108 hours) when it is possible to expect a resumption of M6+ seismic activity on a global scale. This important scientific achievement has not yet received due recognition from the international scientific community and this is, according to the authors, a serious mistake.

Credits

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