Space weather related to M6.0 Tonga earthquake recorded on March 17, 2020

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Abstract

On March 17, 2020, a strong seismic event was recorded in Tonga. The authors verified that this potentially destructive seismic event occurred after a vast increase in the proton density of the solar wind that was recorded starting from March 15, 2020, also Between 15 and 18 March 2020 a general increase in Earth's geomagnetic activity was recorded: the studies conducted by the authors from 2012 to today have shown that the global seismic activity M6+ is always preceded by an increase in the proton density of the solar wind which often even has a significant impact on the Earth's geomagnetic field.

Keywords: proton density increase, seismic precursors, solar activity, Tonga earthquake, seismic prevision.

Introduction

Over the past 10 years, compared to the past, we have witnessed a gradual change of course in the objectives that the international scientific community has set for pre-seismic radio emissions. If in the past these natural phenomena had not received the right consideration, today it seems that we are witnessing a complete re-evaluation of the predictive characteristics of these electromagnetic phenomena to try to develop an innovative seismic forecasting method that is able to identify the seismic epicenter with geographical and temporal accuracy.

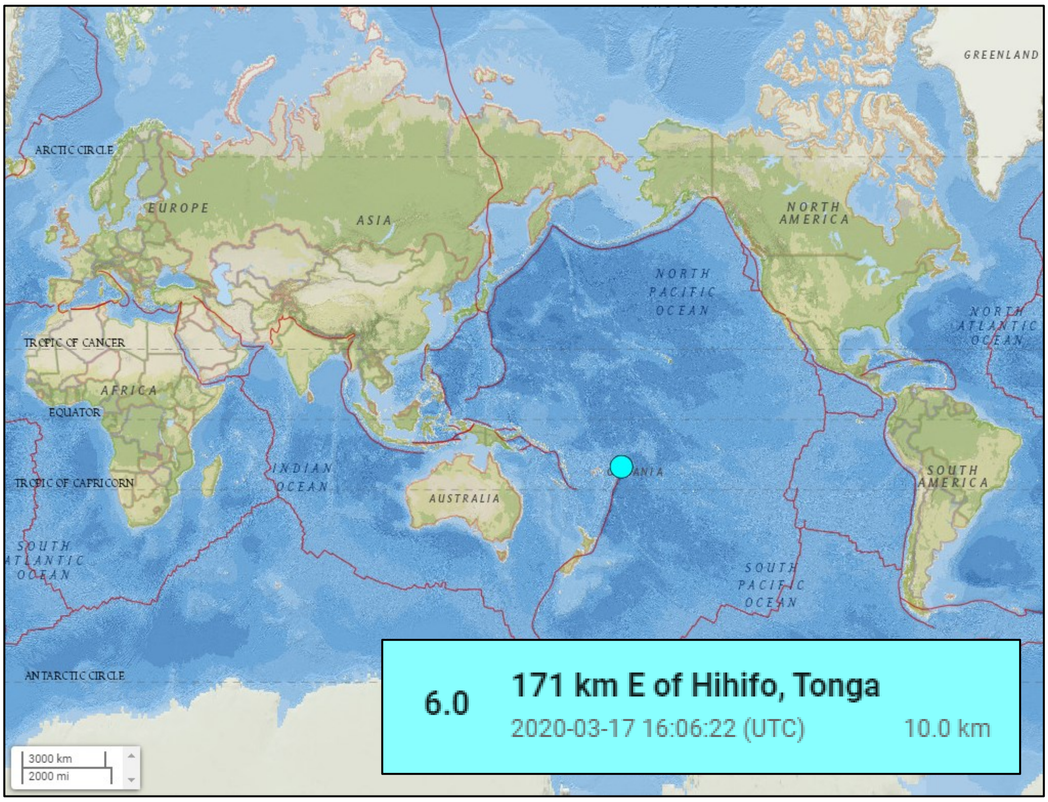

Fig. 1 – Seismic epicenter of M6.0 Tonga earthquake recorded on March 17, 2020. In the image above is visible the seismic epicenter of the M6.0 earthquake recorded in Tonga on March 17, 2020 at 16:06:22 UTC. Credits: USGS, Radio Emissions Project.

The authors of this work are among the leading experts in seismic prediction conducted through the monitoring of solar activity, terrestrial geomagnetic activity and environmental radiofrequency: through studies conducted since 2010, the authors have been able to establish that the potentially destructive earthquakes that are recorded on a global scale are always preceded by a solar wind proton density increase which produces a consequent increase in the Earth's geomagnetic activity [2-15] [17-19] [21] [22] [25] [32] [39] [41] [43] [45-52]. This is an unprecedented scientific discovery that was communicated by the authors in 2013 [1] and which has been reiterated several times every year. In the wake of what the authors have ascertained in the past years, this work will present the results of the studies conducted on M6.0 Tonga earthquake recorded on March 17, 2020 at 16:06:22 UTC (**Fig. 1**).

Data analysis

Between 15 and 17 March 2020, the DSCOVR Satellite (located in Lagrangian orbit L1) detected a solar wind proton density increase which reached its maximum density on March 17, 2020 at 21:53 UTC (**Fig. 2**): the proton increase began on March 15, 2020 at 05:00 UTC preceding the M6.0 Tonga earthquake by approximately 50 hours. Before the proton increase, the basal level of the protons reached the value of 2.4 p/cm^3; after 05:00 UTC on March 15, 2020, the proton density started to increase reaching a first important increase (12.8 p/cm^3) at 17:24 UTC. On March 16, 2020 at 07:38 UTC the proton density reaches a second important increase (20.3 p/cm^3), while at 21:53 UTC it reaches its maximum increase (23 p/cm^3) (**Fig. 2**).

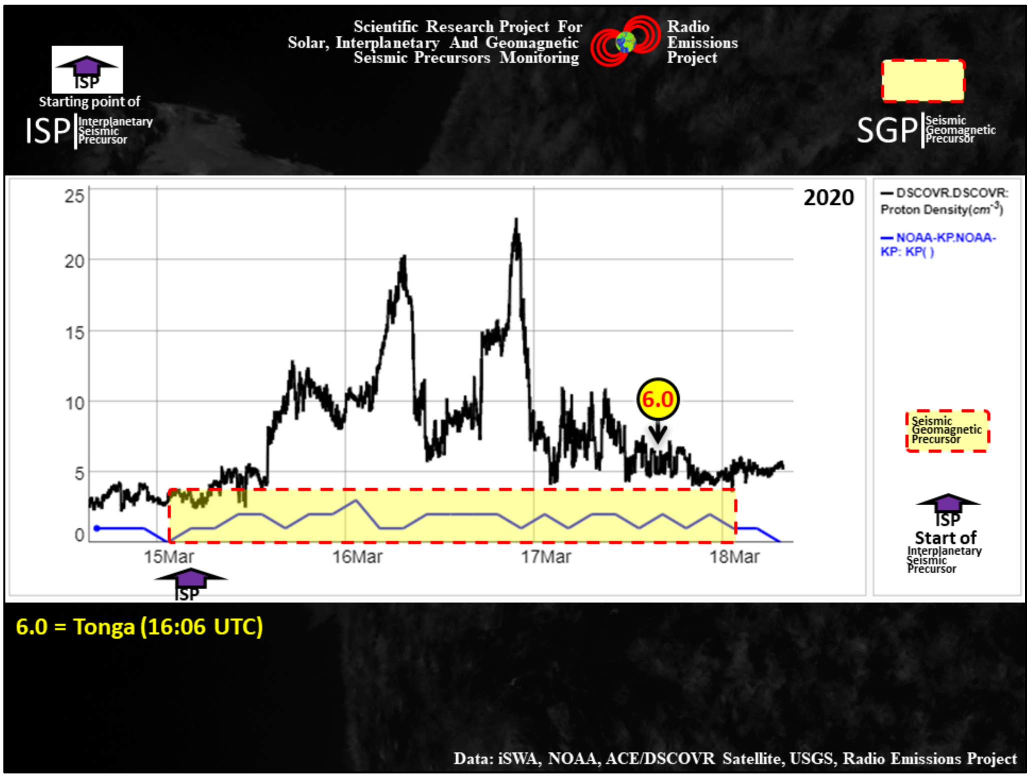

Fig. 2 – Variation in solar ion flux and Earth's geomagnetic activity related to the M6.0 Tonga earthquake recorded on March 17, 2020. The graph above shows the time marker of M6.0 Tonga earthquake recorded on March 17, 2020 at 16:06 UTC (black vertical arrow). Analyzing the data in the graph it is evident that the Tonga earthquake was preceded by a solar wind proton density increase (Interplanetary Seismic Precursor; black curve) and by some increases of Kp Index (Seismic Geomagnetic Precursor; blue curve highlighted by the yellow area) whose maximum value was recorded on March 16, 2020 (Kp = 3). The purple arrow indicates the start of solar wind proton density increase. Credits: iSWA, USGS, Radio Emissions Project.

Also in this case, the authors found a series of prodromal phenomena of electromagnetic nature related to the potentially destructive seismic activity that is recorded on a global scale. The electromagnetic phenomenon that has the highest predictive specificity is represented by solar wind proton density increase (Interplanetary Seismic Precursor or ISP); the second electromagnetic phenomenon related to M6+ global seismic activity is represented by the increase in the Earth's geomagnetic field (Seismic Geomagnetic Precursor or SGP): a phenomenon that is intimately connected to the proton increase (increase in solar activity). Obviously, the magnitude of the geomagnetic increase depends on the magnitude of the proton increase, its speed and the resulting dynamic pressure of the solar wind. To confirm what has just been stated, it is possible to observe **Fig. 3**.

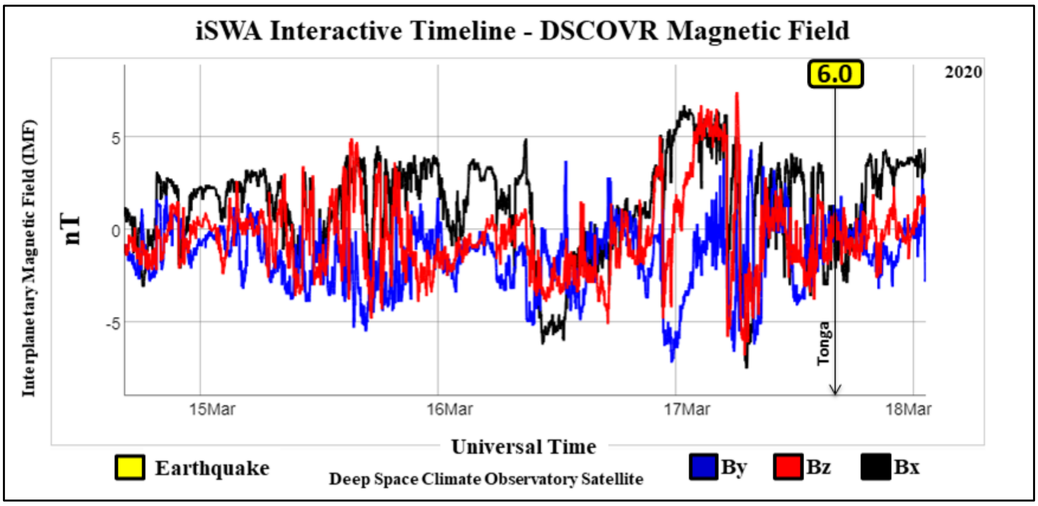

Fig. 3 – Solar wind magnetic field perturbation correlated to M6.0 Tonga earthquake recorded on March 17, 2020. The chart above shows the variation of the interplanetary magnetic field (IMF) recorded through the Deep Space Climate Observatory (DSCOVR) Satellite in orbit at L1 Lagrange point. The recording was done on 3 axes (By, Bx, Bz). Analyzing the variation curves it is evident that the M6.0 earthquake recorded in Tonga has been preceded by a perturbation of the interplanetary magnetic field (IMF) whose greater intensity was recorded between March 16, 2020 at 23:00 UTC and March 17, 2020 at 06:28 UTC. The long black vertical arrow represents the temporal marker of M6.0 earthquakes. Credits: iSWA, USGS, Radio Emissions Project.

Observing **fig. 3** it is evident that the M6.0 Tonga earthquake was preceded by an increase in solar activity which in this case is identifiable as an increase in interplanetary magnetic field (IMF) "near Earth". Certainly, this increase was also supported by an increase in the ionic density of the solar wind (**Fig. 2**): these phenomena have led to an increase in the Earth's geomagnetic activity. Although it is not currently possible to scientifically explain how an increase in solar ion flux can determine a potentially destructive seismic event, the authors can confidently affirm that all potentially destructive seismic events occurring on a global scale are always preceded by an increase in the solar ion flux [2-15] [17-19] [21] [22] [25] [32] [39] [41] [43] [45-52] and it can therefore be hypothesized that the explanation must be sought in a form of electromagnetic interaction that occurs between the solar wind, the terrestrial geomagnetic field and the faults [31] [43]. This hypothesis may seem risky but if we take into account all the data obtained through the correlation study that the authors started in 2012 and which is still active, it is not possible to ignore the fact that potentially destructive seismic activity is always preceded by an increase in the solar ion flux: by

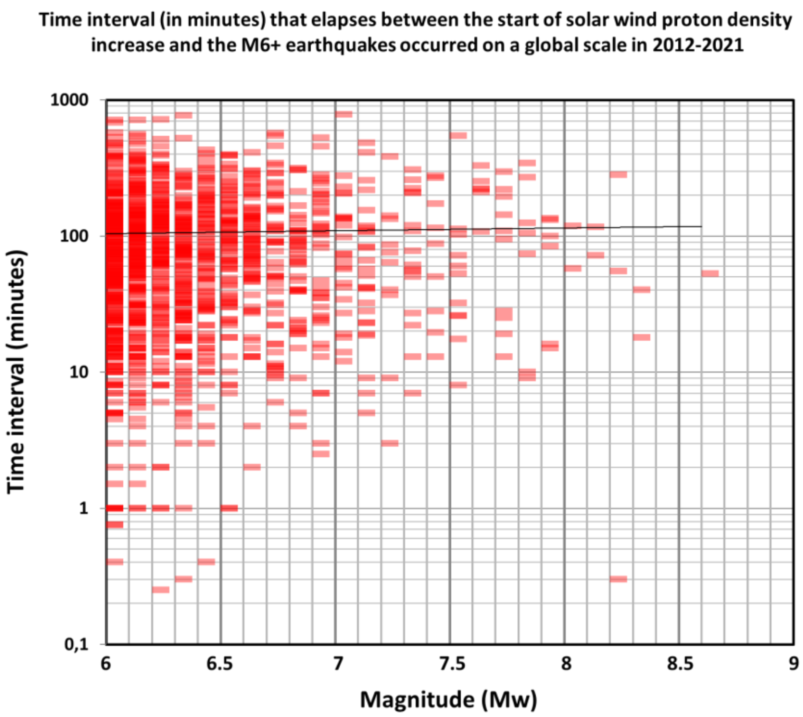

Fig. 4 – Time differences recorded between proton tensity increases and potentially destructive earthquakes recorded between 2012 and 21 July 2021. In the image above it is possible to observe the distribution of the time differences recorded between the proton increments and the earthquakes associated with them. The data sample used corresponds to 1243 M6+ seismic events recorded between January 1, 2012 and July 21, 2021. Credits: iSWA, USGS, Radio Emissions Project.

measuring the time that separates the start of the ion increase and the potentially destructive seismic event that occurs after, it is possible to calculate the average time interval that separates the two phenomena. This corresponds to 106.2 hours (4.42 days) and was calculated by measuring the time intervals of 1243 M6+ seismic events recorded on a global scale between January 1, 2012 and July 21, 2021 (**Fig. 4**).

Conclusions

The study of solar electromagnetic phenomena allowed the authors to verify that there is a close correlation between solar activity and M6+ global seismic activity [41]. This type of correlation is often also evident with an increase in the Earth's geomagnetic activity, the intensity of which essentially depends on the entity of the interaction between the solar ion flux and the Earth's magnetosphere. The authors have not yet understood how solar activity can affect the seismogenesis of strong earthquakes, but the data collected between January 1, 2012 to date confirm that there is a close correlation between these two phenomena. The authors are convinced that the solution must be sought in a form of electromagnetic interaction capable of modifying the static balance of the faults. Currently, the research that the authors are conducting to solve this dilemma have made it possible to acquire new interesting data on pre-seismic radiofrequency through the use of Radio Direction Finding (RDF) technology applied to the crustal diagnosis allowing to identify the seismic epicenter of some medium-low intensity earthquakes that occurred on the Italian territory [24] [26-31] [33-38] [40] [42-44] [53]. Electromagnetic monitoring will therefore be a fundamental resource for research on earthquake prediction [1] [7] [16-18] [20] [31] [43].

Credits

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