

ALERT OF SEVERE EARTHQUAKES WORLDWIDE DUE TO SOLAR FORCING OF VERY WEAK SOLAR CYCLE 24

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Abstract- The declining phase of the very weak solar cycle number 24 is characterized by frequent broad coronal holes. They are the source of fast solar wind streams of velocity about (700 km/s). It is found that when a coronal hole turns towards the earth the solar wind stream is directed to the earth, it triggers a strong earthquake. We have studied three recent strong quakes in October – December 2016 and two in 2017. The central Italy November earthquakes, the 14 November New Zealand Earthquake and the Solomon Islands earthquake. The latter two have magnitude 7.8 Mw.

Our study also covers two 2017 very strong Mexican earthquakes namely; the Mw 8.1 Chiapas earthquake and the Mw 7.1 the central Mexico earthquake. They struck on the 7th and 19th of September however unrelated.

This paper suggests that strong telluric currents induced in the earth's mantle during the accompanying magnetic storms force the earth's plates to move rapidly past each other, collide or sub duct causing strong earthquakes.

Quake lights in the sky could be an evidence for the reaching of solar wind streams to the vicinity of the quake.

Alert of Worldwide Hurricanes and flash floods is also made also due to their initiation by coronal holes fast solar wind streams.

Index Terms- solar cycle 24, coronal holes, coronal mass ejections, solar wind, central Italy earthquakes, New Zealand, Solomon Islands, Chiapas earthquake, central Mexico, Tsunami,

I. INTRODUCTION

Coronal holes have serious implications on solar terrestrial relations. It has been proved that coronal holes can initiate flash floods and hurricanes [1].

Last year I have supervised a M.Sc thesis on the effect of the sun on earthquakes [2]. By the end of October there was a strong earthquake in central Italy. I checked solar data and images [3] and there was a large coronal hole facing the earth. This earthquake was followed by another strong one in New Zealand. Again a large coronal hole was in the right position pointing to the earth.

On the 2nd of December, a large coronal hole was on the southern eastern limb of the sun. I realized immediately that it is going to initiate an earthquake somewhere in the southern hemisphere. This expectation came true, a 7.8 Mw earthquake struck Solomon Islands on the 8th of December [4].

I searched the net and found that there are few references that noticed the same connection between coronal holes and strong earthquakes [5].

It is the aim of this paper to stress the effect of the sun on earth's hazards.

II. CORONAL HOLES

Coronal holes are dark areas in the solar corona (as shown in "Fig.1") of reduced density and open uni-polar magnetic lines of force. This allows the escape of fast solar wind (SW) from their vicinity. For a review of the properties of coronal holes see [6].

At present the sun is in the declining phase of cycle 24, a very weak solar cycle [7]. It is the weakest cycle in 100 years [8]. Its corona is dominated by large coronal holes that extend over large areas either in the solar northern hemisphere or the southern one. Projectiles of high velocity ions and electrons are emanated from such coronal holes.

The solar data used in this paper are taken from [3].

III. THE OCTOBER 2016 CENTRAL ITALY EARTHQUAKES

A series of strong earthquakes struck central Italy between 26 October and 4 November 2016. The strongest were on the 26th and 30th of October with magnitudes Mw 5.9 and 6.5 respectively [9]. Some specifications of those earthquakes are given in Table I. These earthquakes were shallow of depth 8.7 and 9.5 km respectively thus caused serious damage.

These earthquakes are triggered by streams of fast electrons and ions emanated from a large wide coronal hole mainly in the solar northern hemisphere as shown in "Fig.1"

As this coronal hole is very wide, the fast solar wind stream persisted several days as manifested by the long period persistence of aurora. The earthquakes series in central Italy are a consequence of this broad solar wind stream.

IV. THE 14 NOVEMBER 2016 NEW ZEELAND EARTHQUAKES

The 2016 Kaikoura earthquake was of magnitude 7.8 Mw. It struck the South Island of New Zealand early in

the morning on Nov. 14 local time, triggering landslides, tsunamis and hundreds of aftershocks [4]. The earthquake completely transformed the underlying faults in the region. Six major faults ruptured as a result of the quake.

During the quake, bystanders captured videos of mysterious earthquake lights painting the sky in eerie blue and green [10]. As in the case of aurora colors, we the blue and green lights are evidences for the arrival of very fast solar wind streams exiting Nitrogen and Oxygen atoms respectively [11]. A tsunami was also observed, reaching 2.5 m.

The predicted tsunami return periods for New Zealand based on all available data from 1840 are: 1 meter every 7.7 years, 2.5 meters every 10.6 years, 5 meters every 18.1 years, and 10 meters every 52.5 years [12]. The 18.6-year periodicity is found for great earthquakes [13]. The 10.6 and 52 years periodicities are of solar origins [14] - [15].

Quake Date	26 & 30 Oct	14 Nov	8 Dec
Location	Central Italy	New Zealand	Solomon Islands
Magnitude	5.9& 6.5	7.8	7.8
Depth km	8.7&6.5	15	41
Coronal Hole location	North	South	South
Predicted date of SW arrival	25	11-12	7-8
Date of first aurora	25&29	12	8
Velocity Km /s	774 &685	689.8	670
Kp Index	7&5	4	4

Table I: Coronal Holes That Triggered Major Earthquakes 26 Oct-8 Dec 2016

V. THE 8 DECEMBER 2016 SOLOMON ISLANDS EARTHQUAKES

A 7.8-magnitude earthquake hit close to the Solomon Islands on Friday early morning. An Alert of tsunami in the South Pacific was issued [4]. The island was hit by a strong aftershock. The specification of the earthquake and the initiator coronal hole is found in "Table I". A southerly coronal hole was the source of fast solar wind stream of velocity 670 km/s. The earth was predicted to be inside this stream on 7-8 December. The aurora induced by this stream first appeared on the 8th of December and the kp index was 4. The depth of the quake epicenter was the deepest of the three quakes at 41 km.

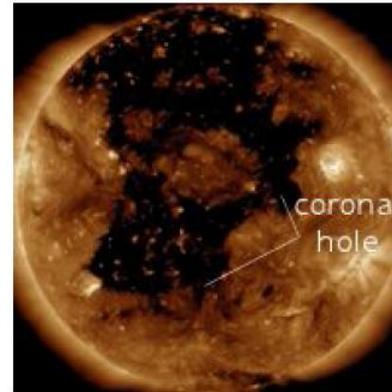
VI. 27 DAYS RECURRENCE OF A CORONAL HOLE

A large northern coronal hole 'fig2" made 3 rotations on the sun." Table II" gives the dates of its central

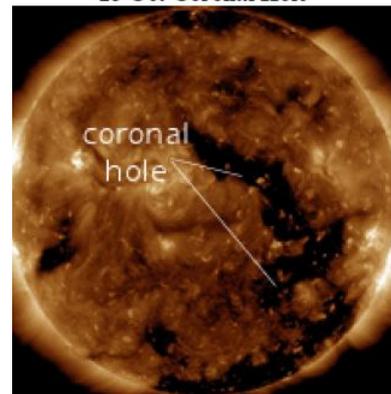
meridian passages when it turned to the earth and its projectile of solar wind hit the earth. It triggered the central Italy and El Salvador earthquake.

VII. EL SALVADOR 7 MAGNITUDE EARTHQUAKE AND HURRICANE OTTO

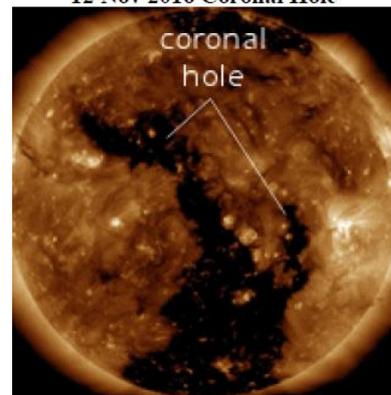
On the 24th of November 2016 Central America was hit by two natural hazards, a 7 magnitude earthquake (4) as well a category 2 hurricane Otto. Both phenomena are triggered by solar wind streams from coronal holes. Hurricane Otto started on November 21 in the Caribbean



25 Oct Coronal Hole



12 Nov 2016 Coronal Hole



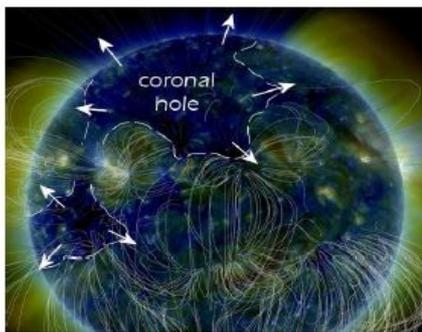
7 Dec 2016 coronal hole

Fig 1. From above to bottom, three large coronal holes (Credit: NASA/SDO) responsible for triggering the Central Italy, New Zealand and Solomon Islands major quakes between Oct 26 - Dec 8 2016. The dates of arrival of fast solar wind streams to the earth are Oct 25, Nov 12 and Dec 7-8. Note that the Oct 25th coronal

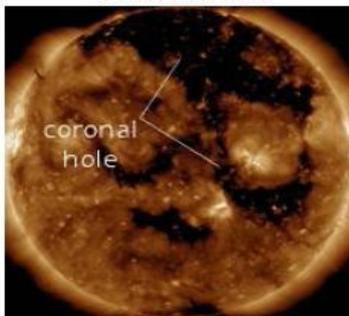
hole is located in the sun’s northern hemisphere while the two others are in the southern hemisphere. Sea as a nascent depression and dissipated on November 26 [16].

It is proposed that a fast solar wind stream hit a particular spot of the troposphere above the Caribbean Sea perhaps on 20 Nov 2016. There the protons, ions and electron energies were deposited and heated the atmosphere. The hot spot expanded and formed a low pressure spot above the Sea thus accelerated evaporation. The electric charges in this particular spot acted as nuclei for water condensation and formation of intense clouds.

As a second step, we propose that solar wind SW streams hit the two polar atmospheres, inducing two surface Meridional wind velocities that moved equator wards. The northern wind and the southern wind met at the cloud spot over the Caribbean Sea and formed a torque that caused the clouds to rotate about the central eye. Thus Hurricane Otto was fully developed on 21 November 2016 from a depression to Tropical Storm Otto. Detailed atmospheric maps may be published elsewhere.



17 December 2016



24 November 2016



26 October 2016

Fig 2. The coronal hole seen on three rotations. 26 Oct, 24 Nov and 17 December (upper image).

Date of central Meridian Passage	Date of Earthquake	Magnitude Mw	Location of Earthquake	SW stream velocity Km/s
1) Oct 25-29	Oct 26-30	5.9-6.5	Central Italy	774 - 685
2) Nov 23-26	Nov 24- 27	7	Near Salvador	527.8
3) Dec 20-22	Dec 21-23? Forecast			

Table II

Data for Three Successive Appearances of the Same Coronal Hole Oct-Dec 2016 and the Corresponding Earthquakes they Triggered

VIII. 8.1 CHIAPAS EARTHQUAKE

On September the 7th 2017 a 8.1 Mw severe earthquake struck Mexico at 23:49:21 CDT. The earthquake caused some buildings in Mexico City to tremble, prompting people to evacuate. It also generated a tsunami with waves of 1.75 meters above tide level; [17].

As for tectonic setting, the Gulf of Tehuantepec lies above the convergent boundary where the Cocos Plate is being subducted below the North American Plate [18].



Fig 3. The location of the Chiapas earthquake.

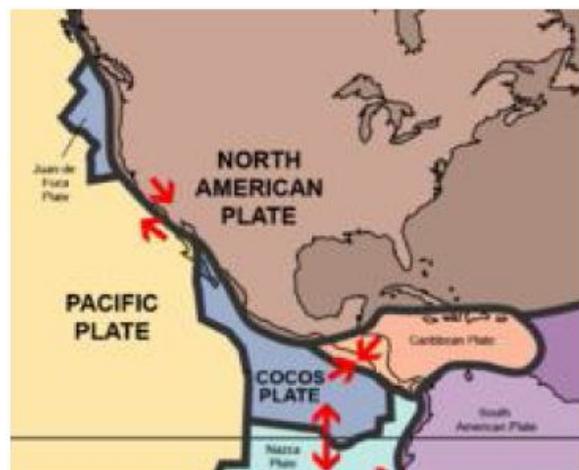


Fig 4. Tectonic plates of Mexico which is at the lower middle part of the picture, to the right of the Cocos plate [19]. Notice the directions of motion indicated by the arrows.

The Chiapas earthquake triggered strange flashes of bright light that spilled across Mexico. These green and blue flashes of light are an unusual phenomenon associated with large earthquakes. Such lights were also observed in the 2016 Kaikoura earthquake of magnitude 7.8 [10].



Fig5. Earthquake light from the 8.1 Chiapas earthquakes [20].

The solar forcing of the Chiapas earthquake can be attributed to a coronal mass ejection CME. A CME is huge magnetized mass ejected from the sun. A Halo CME is that directed towards the earth. On 4 September during a flurry of M-class eruptions, sunspot AR2673 hurled a CME towards Earth. NOAA forecasters correctly forecasted that the cloud was likely to arrive late on Sept. 6th, causing moderately-strong G2-class geomagnetic storms with isolated periods of strong G3-class storming on Sept. 6th and 7th.

On Sept. 6th at 1202 UT, sunspot AR2673 unleashed a major X9.3-class solar flare--the strongest solar flare in more than a decade. X-rays and UV radiation from the blast ionized the top of Earth's atmosphere, causing a strong shortwave radio blackout over Europe, Africa and the Atlantic Ocean: It was accompanied by an earth directed CME [21].

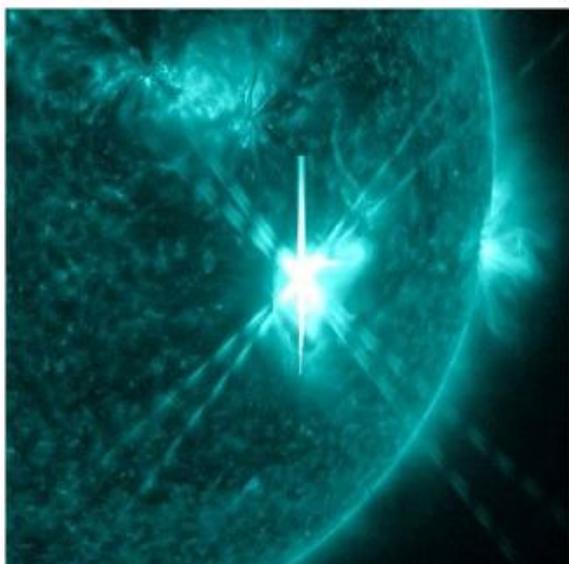


Fig 6. The X9.3-class solar flare on Sept. 6th at 1202 UT

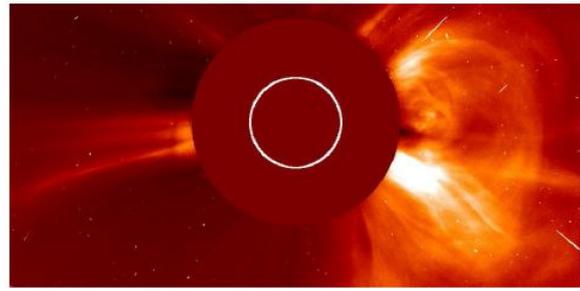


Fig 7. An earth directed Halo CME released from the above shown X9.3-class solar flare [20].

On the 7th of September the Bz component of the interplanetary component was strongly negative reaching -32 nT on 23:56 hour. This strongly negative Bz component, makes an a window opening in the earth's magnetosphere allowing the fast solar wind to leak inside the magnetosphere and makes the coronal mass ejection geo-effective.

Another severe earthquake of M_w 7.1 struck Central Mexico at 13:14 CDT (18:14 UTC) on 19 September 2017. It caused strong shaking for about 20 seconds. It was epicentered about 55 km south of the city of Puebla. This earthquake followed the Chiapas earthquake which was 650 km away by twelve days, As those two earthquakes are widely separated, they are not related [20].

Unlike the Chiapas earthquake which was initiated by coronal mass ejection, the central Mexico earth quake could be attributed to solar wind streams emanated from a northern coronal hole for several days.

CONCLUSION

It is evident that when coronal holes turn to the earth, streams of fast solar wind hit the earth. This declining phase of the extremely weak solar cycle number 24 is characterized by broad coronal holes. This makes the earth inside the fast solar wind streams for long time. The evidence comes from prolonged auroras nights.

These Solar wind streams somehow trigger strong earthquakes. In earlier work, we found that very strong earthquakes are correlated with proton flares [2]. Since proton flares are accompanied by type II and Type IV shock waves on the sun and by coronal mass ejections, then we can conclude that the very severe earthquakes are initiated by coronal mass ejections. The observations of quake lights during the earthquake can be attributed to interactions of protons, ions and electrons with atoms in the earth's atmosphere.

Intense Sub surface Telluric currents are induced during magnetic storms resulting from solar wind streams. We suggest that such telluric currents in the magma cause the earth's plates to move particularly around the ring of fire causing the plates to interact thus trigger earthquakes.

It is likely that northern solar coronal holes trigger strong earthquakes in the northern earth's hemisphere

while southern coronal holes cause strong earthquakes in the southern earth's hemisphere.

Since cyclones and hurricanes are also initiated by fast solar wind streams from coronal holes, and since coronal holes dominate the declining branch of solar cycle 24. A forecast of frequent aurora, magnetic storms, hurricanes and earthquakes in the next few years is strongly made.

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REFERENCES

- [1] Shahinaz Yousef, Y. H. O. Algafari, Z. Al-Mostafa, and M. Kordi, "Solar Forcing on Makkah Al-Mukaramah Flash Floods", *Journal of Earth Sciences and Engineering*, vol. 2 number2, Feb serial number 5, issue ISSN 2159-581X, pp. 77-83, 2012. journal_of_earth_science_and_engineeringvol1no120111.pdf
- [2] Sara Said Khodairy, Mahmoud Salah El Hadidy, Mohamed Ahmed Semeida, Rabab Helal Abdel Hamed, Shahinaz Mostafa Ali Youssef, "Relationship between Seismicity and Solar Activities during Solar Cycle 22" *Int. J. of Adv. Res.* 3, (2). 2015. www.journalijar.com
- [3] Space Weather: <http://spaceweather.com/>
- [4] Powerful Pacific Plate Earthquakes November-December 2016 <http://www.crystalinks.com/EarthquakesNovDec2016.html>
- [5] B. Davidson, "Research Update on Solar Polar Fields/Coronal Hole IMF and Large Earthquakes, and a Proposed Method for Quantifying Coronal Hole Geo-effectiveness", *Space Weather News*, LLC & The Mobile Observatory Project, 2015. <http://www.suspicious0bservers.org/wp-content/uploads/2016/04/NewPaper-4.pdf>
- [6] Steven R. Cranmer, Coronal Holes. *Living Rev. Solar Phys.* 6, 3, 2009. [url:http://www.livingreviews.org/lrsp-2009-3](http://www.livingreviews.org/lrsp-2009-3)
- [7] Shahinaz Yousef, "Cycle 23, the first of weak solar cycles series and the serious implications on some Sun-Earth connections", 2003. SAO/NASA Astrophysics Data System (ADS) adsabs.harvard.edu/full/2003ESASP.535..177Y
- [8] Leif Svalgaard, Edward W. Cliver, and Yohsuke Kamide, "Sunspot cycle 24: Smallest cycle in 100 years?", *Geophysical Research Letters*, Vol. 32, L01104, doi:10.1029/2004GL021664, 2005.
- [9] Istituto Nazionale di Geofisica e Vulcanologia <http://webservices.rm.ingv.it/fdsnws/event/1/query?starttime=2016-10-26T00%3A00%3A00&endtime>
- [10] New Zealand 2016 Earthquake Mysterious Lights - youtube https://www.youtube.com/watch?v=UnyyRq_i8ck
- [11] Aurora Zone, Why are the Northern Lights sometimes colored differently? <https://www.theaurorazone.com/about-the-aurora/the-science-of-the-northern-lights>
- [12] Willem de Lange and Rodger Fraser, Tephra, Table, "Tsunami Hazard in New Zealand", Ministry for Emergency Management, page 4, October 1999, Cited in Tsunamis affecting New Zealand, Wikipedia. https://en.wikipedia.org/wiki/Tsunamis_affecting_New_Zealand#cite_note-Tephra-3
- [13] P.R. Du, Zhao Junmeng and X.L Gao, "The 18.6-year periodicity of great earthquakes", *Chinese Journal of Geophysics- Chinese Edition* 54(9):2256-2262, 2011..
- [14] Douglas V. Hoyt, Kenneth H. Schatten, "The Role of the Sun in Climate Change". p 146, Oxford University press `1997.
- [15] Om. Moses, "signs in the horizons", *Academic Journal of Scientific Miracles*, , Vol. 37 No. 1 pp 1-20, 2015. www.academya.net/miracles/paper/miracles.37.1.pdf
- [16] Wikipedia "Hurricane Otto 2016".. [https://en.wikipedia.org/wiki/Hurricane_Otto_\(2016\)](https://en.wikipedia.org/wiki/Hurricane_Otto_(2016))
- [17] Pacific Tsunami Warning Center (8 September 2017). "Tsunami Message Number 17". Ewa Beach, Hawaii: National Weather Service. Retrieved 8 September 2017.
- [18] Wikipedia after Taylor, Adam (8 September 2017). "Mexico's cataclysmic history of earthquakes". *The Washington Post*. Retrieved 8 September 2017.
- [19] 2017 Central Mexico earthquake Wikipedia. https://en.wikipedia.org/wiki/2017_Central_Mexico_earthquake
- [20] Trevor Nace , 8.1 Earthquake Strikes Mexico: Produces Mysterious Bright Flashes Of Light. <https://www.forbes.com/sites/trevornace/2017/09/08/8-2-earthquake-strikes-mexico-produces-mysterious-bright-flashes-light/#4198f5023868>
- [21] SpaceWeatherLive.com <https://www.spaceweatherlive.com/en/news/view/303/20170906-x93-earth-directed-coronal-mass-ejection>

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