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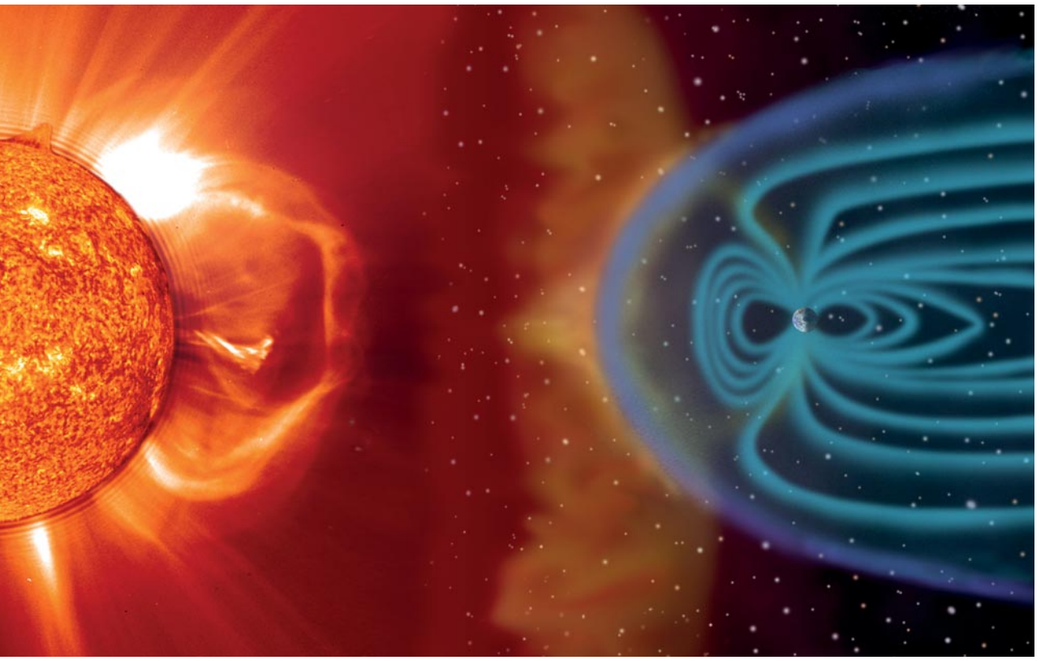
IMAGE: THE EUROPEAN SPACE AGENCY (ESA)

The last point of the bell – Coronal Mass Ejections



For a statistician Black Swan events belong to the far left of the bell. For an actuary these events have to be priced with an appropriate probability to quote competitive prices. For an (re)insurer policies have to be sold worldwide to diversify the occurrence of them. However, there is one type that is not diversifiable but not apocalyptic to make it irrelevant, and that is a coronal mass ejection – CME- from our parent star the Sun.

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Sun's warmth and pull on planet earth, is what keeps it together from imploding into itself or exploding apart, in a billions of years equilibrium between gravity and nuclear fusion, that arose from a natural process. However, in all natural processes there are always errors (deviations from the equilibrium) that can disrupt such a balance resulting into an exploding star. Luckily our sun is not that young or big for an unexpected lifecycle correction to occur (the distribution of its errors has short tails), but it can still experience smaller events from smaller disruptions in each "day-to-day operations".

THE ENERGY OF SUCH EJECTIONS EXCEEDS THE POWER OF THE MOST POWERFUL MANMADE NUCLEAR WEAPONS

Such events are Coronal Mass Ejections or CMEs. CMEs are in a way, mini explosions on the surface of the sun that can cause super-charged particles (plasma) to be ejected with low end relativistic speeds into all directions of the solar system. The energy of such ejections exceeds the power of the most powerful manmade nuclear weapons by millions of times and can easily sterilize most life on earth if so much radiation was released into our environment. CMEs are not that uncommon with our parent star with an average occurrence of 5 per day during a solar maximum and 1 every five days during solar minimum (a 11 years cycle). Although this sounds very grim, if you take into account the frequency and severity, our solar system is so vast and our planet so small in this cosmic scale, most of CMEs miss us and they either hit other objects or more likely travel forever towards interstellar space.

What about the corner cases though that are directed towards us and actually hit earth? These should not scare us either, due to our planet's spinning molten metal core that provides powerful filtering protection through the resulting magnetosphere effect, and its orbiting low-atomic-weight gas bubble we call atmosphere.

With all these natural means of protection for all living organisms, CMEs never bothered the course of life, and even the tiny residual amount of radiation that still reaches us after all these great filters, it is something that always existed and life managed to adapt through billions of years of evolution. However, all this natural shielding against the tantrums of our star has some side effects when it's at work. These side effects are coming from our magnetosphere where if an enough powerful CME hits it, it can cause a geomagnetic storm. In simple words: it's like someone puts a giant planet size magnet next to earth. Fortunately this is still harmless for us, as we all played with magnets as kids with our parents' permission where we also noticed that magnets can cause old screens to lose accuracy, speakers/microphones distorting sound, and in general electrical circuit appliances to be affected.

IN COMPARISON TO THE CARRINGTON EVENT THE DAMAGES WOULD BE IN THE TRILLIONS OF EUR

Knowing that a magnet can disrupt electrical circuits, a giant magnet could disrupt electrical circuits on a global scale. This was observed for the first time during the Carrington event on September 2nd 1859, when a powerful CME hit earth directly, causing a geomagnetic storm. Telegraphs starting receiving/transmitting gibberish messages, electrical wires caught fire with some people being electrocuted, the Northern lights being visible as south as the Caribbean, and the sun appearing with the naked eye brighter than normal. Although that event was probably terrifying for the people at the time, its impact was very limited due to the low dependency of the civilization on technology that relies on electricity.

Nowadays our dependency on technology is many orders of magnitude higher than in 1859. First our satellites that are on the first frontier will take the hit, disabling/compromising communications and navigation and possibly making state of the art technology, orbiting earth for our service, space junk. All electrical circuit-based technology on the ground can be affected too, hampering many sectors that depend on robotics, flow of information, and digital data storage (e.g. pilots flying airplanes and depending on thousands of systems to work together, doctors that use electrical equipment to operate/support patients, banks that depend on fast flow of information and vast digital archives, government defense systems). Let alone all technological amenities we all enjoy in our daily life. In comparison to the Carrington event the damages would be in the trillions of EUR. This was estimated in 2012 from a similarly powerful CME that fortunately was not directed to us and we only missed by nine days. In 1989 a lower intensity event occurred that mainly hit Canada and some parts of the Northern Unites States causing indeed blackouts, leaving people in the dark, and jamming of the communication lines that was thought to be done by the USSR.

In a good case scenario the geomagnetic storm hits the empty hemisphere and only the satellites are impacted. Depending on this impact, it can affect GPS that can cause delays or even accidents in sea and air commercial routes. Lack of internet can hit the efficient price discovery in the financial markets, causing a market crash. In a bad case scenario, apart from the satellites, technology that lies on the ground and relies on wires, dynamos, computer chips will be compromised. Cold climate countries can experience blackouts wiping out our defense towards the cold weather (similarly for exotic weather places where people rely on climate control systems). These blackouts can also compromise water treatment plants, means of public transportation, and computers. Knowing how integrated these basic things are for virtually everyone, and that besides the lack of electricity a CME can also render them useless even after the blackouts, examples on the consequences are limited only to the imagination.

Coming back to the un-diversifiable nature of such an event it is hard to estimate how big the damage can be or what portion of the globe will be directly affected, but given how interconnected the world is currently, from a non-life actuarial perspective it cannot be addressed as a weather phenomenon (hurricane, storm, drought) that can hit the US and leave Australia unharmed. There is no proposal here for an alternative to price such a risk but more of raising awareness on an interesting tail scenario that is related with physics. Moreover it is not clear if worthy to even take it into account, since in each full potential can be apocalyptic in a way that erases years of progress – particularly in data storage technology where the bank does not know who owes or owns anything and in that case an insurance claim is basically "unclaimable". ■

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