

Solar Storm: A Geophysical Phenomena

By

Eboh, Daniel Onyi

Geology/Physic Student,

University of Nigeria Nsukka, Enugu State, Nigeria.

This is the world in constant change and scientific observation of character produces volumes of data. We are interested in the sun because of the many influences: That's on our lives and our environment.

Solar storms (a.k.a magnetic storms) is defined by Bates and Jackson (1984) as a world- wide disturbance of the Earth's magnetic field with an amplitude of 50-200 gammas. Constant (1972) explains that a solar flare is accompanied by a bust of electrically charged particles (icon) and radiations that are ejected from the sun at speeds of thousands of mils per hour. On reaching Earth, this particular and radiation magnetic (these energetic particles and electromagnetic radiations are collectively called plasma because they are electron and protons from the sun). NOAA and U.S. Dept. of commerce (1998) further explains that when outer solar atmosphere (the corona) suddenly and violently releases bubbles/tongues of gas and magnetic fields that are termed coronal mass ejections (CME). Therefore, solar flares (which cause solar storms) are intense, temporary releases of energy which are seen at ground-based observatories as bright areas on the Sun in optical wavelengths and as bursts of noise at radio wavelength (they can last from minutes o hours). Flares are our solar system's largest explosive events, equivalent that magnetic storms occur when a mass of plasma containing trapped magnetic field is ejected from the sun and strikes the Earth and its atmosphere. The U.S Dept of The Interior and USGS (2000) describe our present society as being more and more dependent upon advanced technological systems that can be adversely affected by solar storms. High-energy pulse of solar winds from solar bursts or plasma bubbles travel from the sun to the Earth at speeds exceeding 500 miles per second. The pulses distort the Earth's magnetic field and produce solar storms that disrupt the Earth's environment. It is important to explain that the magnetosphere, which is the region in space (occupied by the Earth's magnetic field) usually extends to outwards for 40,000 miles (64,000km) on the sun ward sides but fierce solar storms can compress the magnetosphere to only 26,000 miles (42,000 km) exposing high-orbiting satellites to the solar wind.

However, solar storms can be measured with an instrument called a magnetometer. Let's briefly look at the properties of solar storms.

Solar storms display several distinct properties such as:

- they are supersonic at earth's orbit
- they consist of electrons and protons with a few percent of x-ray particles and heavy nuclei
- their energy is more directed than random (the flow is radial from the sun)
- it is a principal medium through which the activity of the sun is communicated to the environment of the Earth.

Solar storms affect several spheres of our lives as outlined below:

1. Geologic Exploration: geologists to determine subterranean rock structures use Earth's magnetic field. Geodetic surveyor's search for oil/gas/mineral deposits only when Earth's field is quiet, so that the true magnetic signature can be detected. Other surveyors prefer to work during solar storms, when the variations to Earth are normal subsurface electric currents help them to "see" subsurface oil or mineral structures. However, Q¹⁵⁵ explains that a compass needle on the sunlit side of the earth gives a sudden jerk called a magnetic crotchet, as a result of the eruption of a solar storm. Therefore, solar storms affect the following systems of geophysical exploration:
 - Seismic wave propagation and instrument
 - Magnetic methods/ surveys
 - Seismic reflection methods
 - Electromagnetic surveying
 - Gravity methods
- 2 Biology: There is a growing body of evidence that changes in the geomagnetic field affect biological system. For example, there has been the degradation homing pigeons navigation ability during solar storms. Pigeons and other magnetron animals (dolphin and whales) have internal biological compasses composed of the mineral magnetic wrapped in bundles of nerve cells. This has resulted in many pigeon race "smashes" (a term wed to describe when a small percentage of birds return from a release site).
- 3 Power: when magnetic fields move about in the vicinity of a conductor (wire), an electric current is induced in to the conductor. This happens on a grand scale during solar storms. Q⁶³ explain that the magnetic field jolted by blasts from the sun, cause electrical surges in power lines blowing out { burning out } trasformers. Four ideal case studies of the affect of solar storms on power line or outlined as followed:
 - {1} January 1997- solar storm completely damaged the U.S Telstar 401 communication satellites worth \$200 million..
 - {2} 1994 - solar storm damage two Canadian communication satellites.
 - {3} States that on March 13 1989 in Montreal Quebec {Canada } a solar storm knocked out Hydro – Quebec transformers leaving 6 million residents in eastern Canada, northeastern U.S and Sweden without power for 9 hours at a cost of at a cost of \$300 million.
- 4 Radio Transmission: solar outpourings can degrade / disrupt communications between ground controllers and satellites The solar storm interferes with long – distance telephone reception and which we can here static in radio recovers. However, during solar storms, some of the energetic proton will pass through satellites and cause satellites electronics to experience bit flips or latch- ups and solar power cells that drive the satellites will be degraded.
- 5 Aurora: Solar storm distort the Earth's magnetic field to create the comet-shape magnetosphere. This act as a barrier, protecting the Earth from energetic particles and radiation in the hot solar storm. Most of this energetic particles are deflected

around the Earth by the magnetosphere, but some get trapped. Electron trapped in the Earth's magnetic field are accelerated along the magnetic field towards the polar Regions and they strike the atmosphere to form the aurora. Therefore the aurora { glow in the up atmosphere } result from collisions between solar and from terrestrial atoms high in the atmosphere. Therefore, J³ explains that the aurora is a dynamic and delicate visual manifestation of solar-induced storm.

COPING WITH SOLAR STORMS: Early warnings

I^{4,8,7} explain that whereas forecasting the affects of solar storms is in the infancy, the U.S government possesses the technical mean to improve understanding forecasts and services related to these events.

To avoid losses, I strongly advice to the following measure:

- {A} Satellites = Put a satellite "to sleep", turn off sensitive spacecraft subsystems and calculate the best time to adjust the low orbit for drag.
- {B} Power = Disconnected links between power grids and delay power station maintenance / equipment replacement.
- {C} Surveying = Delay high – resolution land surveying, exploration, or other research using GPS.

Finally, it is necessary that more in-depth research is carried-out in to solar storms so as to be able to predict them and therefore issue out timely alerts and warnings to various.

Definition of Keywords.

1. Solar winds the constant flow of charge particles from the sun. it stream past the Earth at less than 1.6 million km/h
2. Magnetosphere = A comet-shaped terrestrial magnetic shield.
3. Solar radiation storm = Definition used by NOAA space environment center to describe time period of large increase in solar particles above 10mev. Increase can last several days and be more than 100,00 time the background level.
4. Mev = Mega {million} electron volts. A unit of energy equal to the kinetic energy carried by particles.
5. Plasma = The fourth state of matter

REFERENCES

Robert L. Bates & Julia A.. Jackson, Dictionary of Geological Terms(1984),by Anchor Press/Doubleday,New York.p309.

A Primer On Space Weather by National Oceanic & Atmospheric Administration(NOAA)-Space Environment Center and the U.S Department Of Commerce,Boulder,Colorado(December 1998) pp1-13.

Constantine Constant, Earth Science Workbook(1972) by AMSCO School Publications Inc, New York.p257.

“On The Watch For Geomagnetic Storm” in Reducing The Risk From Geomagnetic Hazards(10/13/00 =12:37pm) by the U>S Department Of The Interior & U>S Geological Survey, USGS Fact Sheet 177-97 (INTERNET PRINT) pp1-6

Edward J. Anderson, Earths Atmosphere (1963) by Wheaton Of Exeter p155