

THE SOLAR ACTIVITY AND GEOMAGNETIC STORMS IN BELGRADE AREA

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Abstract. The Solar activity has a great influence on the upper magnetosphere features. The Solar wind, causes a number of changes in the geomagnetic field, called geomagnetic storms. This phenomenon is presented in the paper, illustrated by numerous magnetic storms in Belgrade area in the period 1975-1995.

1. THE SOLAR ACTIVITY

The Sun exhibits several repetitive cycles and the most familiar, spanning 11 years, brings increased sunspots activity and develops increasingly intense flares which interact with the Earth's magnetic field to perturb the transmission and reception of radio waves. Other long-period cycles are suspected which may have influenced the ice-ages on Earth, but currently the trend is towards an increasingly hot Sun.

At the top of the Sun's chromosphere temperatures rise dramatically to meet the transition zone of the corona, a diffuse atmosphere of ionized gas where temperatures reach 3 million degrees. Although the Sun's corona is diffuse and invisible through the intense light radiated from the surface, it can be studied during an eclipse or from a satellite that provides an artificial occultation by placing a disc over the image of the photosphere.

The corona extends several million kilometers from the Sun and emits a stream of particles, protons and electrons into the solar system at 300-600 km/s. This solar wind impinges on planetary bodies or sweeps round the magnetic field of Earth. The force of the solar wind fluctuates according to the magnitude of emission rates, while the rotation of the Sun creates a spiral effect in the released particles. The wind is thought to extend some 5×10^8 km into the solar system where the heliosphere is no longer of sufficient strength to resist incoming particles from other star sources (Baker, 1984).

2. THE INFLUENCE OF THE SOLAR ACTIVITY ON GEOMAGNETIC FIELD

It is well known that Solar activity has remarkable influence on the upper atmosphere features. This effect can be explained by variation of Solar ultraviolet radiation which

descends to the Earth. Fluctuation of corpuscular radiation power, especially of Solar wind, causes a great change in the atmospheric parameters. There exists an empirical relation between Solar radiation flux at wave-length of 10.7 cm, number of Sunspots, and characteristics of upper magnetosphere (Ivanova, 1981).

Besides on atmospheric variations that are connected with ultraviolet radiation in the Solar interior, there are, also, variations that are provoked by geomagnetic activity. Reaction of atmosphere on the geomagnetic perturbation, lasts for 7.2 ± 0.3 hours at latitude 25° , and for 5.8 ± 0.5 hours at latitude 65° . Within intensive geomagnetic storms, the density of atmosphere at heights of 130 to 250 km, rises by 10-30%.

Until nowadays, there are several possible mechanisms of acting of the Solar-geophysical factors on magnetosphere and lower atmosphere (Kazimirovskiy, 1976; Ivanova, 1981; German, Goldberg, 1981; Milovanović, 1991). One of these mechanisms is alterations of the Solar constant and infrared radiation, phenomena that happen during intensive geomagnetic storms. The other mechanisms are those which restore perform to lower atmosphere and which are connected with the Solar and geomagnetic variations and their effect on the atmospheric electricity parameters. The mentioned mechanisms are constituent components of the total exchange of energy in the Sun-Earth system.

Numerous of changes on the Sun, cause the enormous effect on the Earth's magnetic field, that makes the appearance of intensive magnetic storms.

3. MEASUREMENTS OF GEOMAGNETIC STORMS

Geomagnetic Observatory Grocka near Belgrade, conducts permanently measurements of several parameters of Earth's magnetic field. The horizontal component of magnetic field is especially sensitive to changes of that field with time. Each sudden change of horizontal component more than 100 nT, is caused by Solar activity and may be called geomagnetic storm.

There is evident connection between Solar activity (number of sunspots, Sun flares and other changes on Sun surface) and the number of geomagnetic storms registered at Geomagnetic Observatory Grocka (Mihajlović, 1993).

The correlation between some Sun characteristics (number of sunspots) and Earth's magnetic field (H component) in Belgrade area for 1982 and 1983 is given in Figures 1 and 2 (Geomagnetski godišnjak, 1982-1990).

There is evident connection between the number of sunspots and intensity of Earth's magnetic field (H component) in both examples presented in Figures.

The picture of Sun's disk on July 13th 1982 is presented in Fig. 3 (left). The geomagnetic storm intensity of over 400 nT is probably caused by sunspot 474. Magnetic field of the Sun surface for the same date is presented in Stanford Magnetogram (Fig. 3, right). The position of magnetic anomalies corresponds to position of sunspots. Solid lines represent positive values, and dashed lines negative values of Sun magnetic field.

The practical significance of geomagnetic storms registration is very great. There was established connection between atmospheric parameters and variations of geomagnetic field. Great variations, called geomagnetic storms, cause changes of some atmospheric parameters (e.g., temperatures) several days later.

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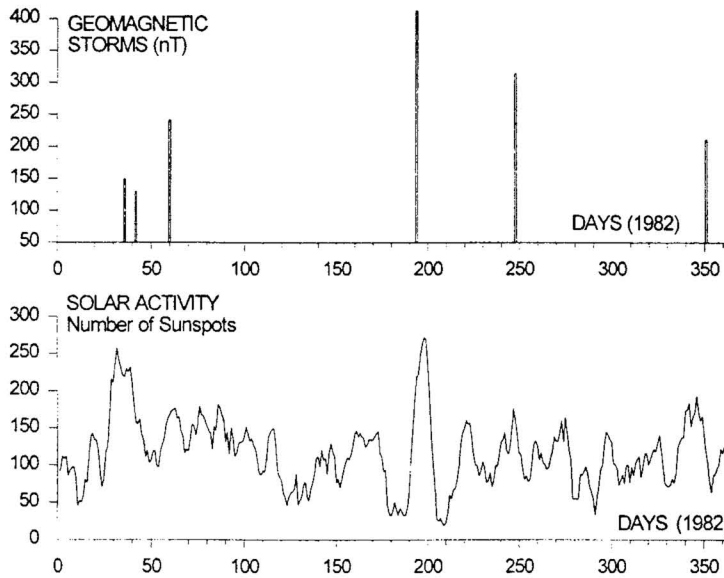


Fig. 1. The correlation between geomagnetic storms and the number of sunspots in Belgrade area (1982).

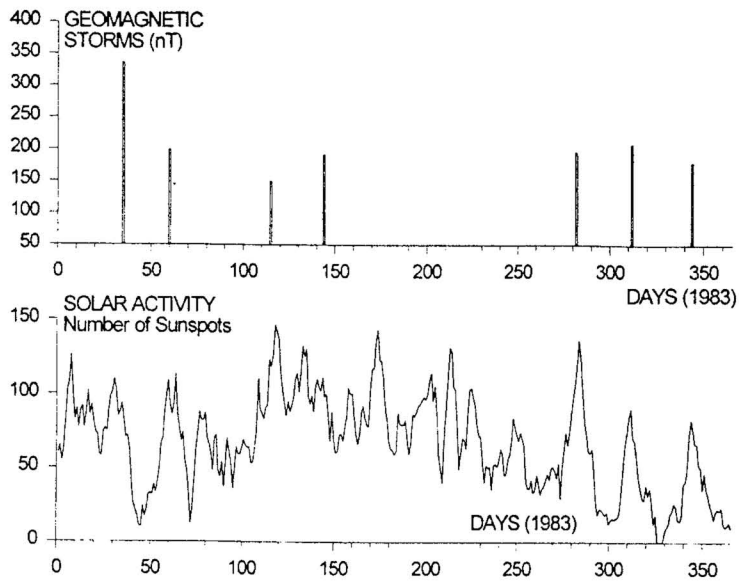


Fig. 2. The correlation between geomagnetic storms and the number of sunspots in Belgrade area (1983).

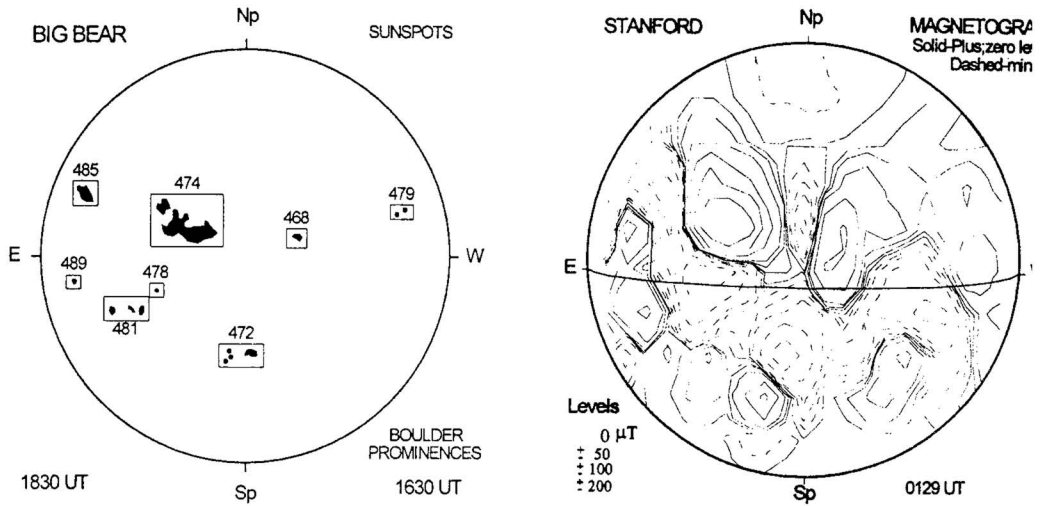


Fig. 3. Sunspots (left); Magnetogram (right), July 13th, 1983.

Some investigations made for Belgrade area, show relationship between geomagnetic storms and human health: several days after storm registration, much more urgent interventions are registered. These investigations are not yet completed.

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