EFFECT OF SOLAR FORCES ON EARTHQUAKES

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Summary: *Information about effect of solar forces on global seismicity are presented.*

Key Words: *solar activity, earthquakes.*

The sun radiates energy uniformly in all directions and the Earth intercepts and receives part of this energy during rotation around the sun. The source of almost all the energy on Earth is the sun. Changes in the Earth's system atmosphere, hydrosphere, biosphere and lithosphere (sedimentary rocks) depend on continuous stream of particles flowing outward from the Sun.

Sun loses about 5.5 million tones of mass every second or about 174 trillion tones of mass every year.

1. The radiation pressure of sunlight.

The radiation pressure of sunlight on earth is equivalent to that exerted by about a thousandth of a gram on an area of 1 square meter (measured in units of force: approx. 10 μN/m2).

Taking into account Earth's surface area – 510 072 000 km², the total pressure acts on the surface of the earth with force of many billions kg/force in year.

Thus, the solar radiation reaching Earth's upper atmosphere exerts a pressure (force) of sufficient magnitude to perturb equilibrium of the Earth's tectonic plates.

2. Magnetic field of earth.

The continuous stream of solar particles (solar wind) pushes Earth's magnetic field. As a result, the geomagnetic field, acting as an electromagnetic barrier, is compressed in the direction towards the Sun and is stretched into a (tail) in the direction away from the Sun. Fluctuations in its speed, density, direction, and entrained magnetic field strongly affect Earth's local space environment.

The pressure of the solar wind on Earth's magnetic field compresses the field on the dayside of Earth and stretches the field into a long tail on the nightside. On the dayside of Earth, rather than extending to infinity, the magnetic field is confined to within about 10 Earth radii from the center of Earth and on the nightside, the field is stretched out to hundreds of Earth radii, well beyond the orbit of the moon at 60 Earth radii.

The interaction between the solar wind and Earth's magnetic field, and the influence of the underlying atmosphere and ionosphere, creates various regions of fields, plasmas, and currents inside the magnetosphere such as the plasmasphere, the ring current, and radiation belts.

3. Gravity changes

Gravity change also deforming the Earth and cause earthquakes. Einstein envisioned gravity as a bending of space-time by mass. The geodetic effect is the warping of space and time by the gravitational field of a massive body (in this case, Earth).

GRACE detected a migration pattern of gravity changes due to deep and crustal processes a few months prior to the 2011 Tohoku (Japan) earthquake [Panet et al.2018].

Most earthquakes occur along the edge of the oceanic and continental plates.

Sediment transport is the movement of solid particles due to a combination of gravity acting on the sediment and the movement of the fluids in which the sediment is entrained. The force of gravity acts to move the particles along the sloping surface on which they are resting. Sediment transport due to fluid motion occurs in rivers, oceans, lakes, seas, and other bodies of water.

The aim of this study, to identify the Sun generated forces contribution on total amount of earthquakes occurred on the Earth. As a main physical value of presented forces effected on the Earth was chosen Total Solar Irradiance.

World quakes growth trend over the period 1700-2010 can be described as:

$$Eq=7E\text{-}08e^{0,01x}$$

Relationship between solar activity and global seismicity in 1680-2012 reveals a good correlation:

$$EQ= 33,45TSI – 45667, r = 0,79.$$

-where Eq-amount of significant World quakes, TSI-total solar irradiance in W/m², r – correlation coefficient.

Geomagnetic activity.

Relationship of earthquakes from aa-index over the period of instrumental observation 1867-2008 shows also good correlation:

$$EQ = 1,15aa + 0,55; r= 0,75$$

References

Panet I., Bonvalot S., Narteau C., Remy D., Lemoine J. M. Migrating pattern of deformation prior to the Tohoku□Oki earthquake revealed by GRACE data. // Nature Geoscience, 11(5), 2018, 367. https://doi.org/10.1038/s41561-018-0099-3