

Ecological Management and the Cosmogenic Mechanism of Earthquakes

Zhanna Mogiljuk^{1,*} and Michael Hlystunov¹

¹Moscow State University of Civil Engineering, 129337 Yaroslavskoe sh. 26, Moscow, Russia

Abstract. Critical issue of ecological risk management in urban areas is to predict the evolution of the dangerous natural processes intensity. The special situation in the realization of these risks take the earthquake threat and the stresses emergency fluctuations in the geological environment of the buildings and structures bases. This article is devoted to one of the main problems of earthquake engineering - verification of the dominant mechanisms and causality of the earthquakes intensity dangerous evolution. In it discusses the comparative analysis results of the Earth gravitational interaction energy variations amplitudes with the Sun, with the Moon and the solar system planets. Also presented the comparative evaluations results of the Earth geospheres gravitational perturbations amplitudes with the Earth solar radiation energy with the energy of its own heat of the Earth. It is shown that the energy of his own heat and Sun exposure of the Earth much less energy to gravitational perturbations in the near-earth space. In the article presents the spectral analysis results of earthquakes global daily energy on the Earth before and after the Shoemaker-Levy comet explosion on Jupiter. It is shown that the seismic events number on Earth with magnitude greater than 2.5 on the Richter scale after the comet explosion increased in 10 times. In the earthquakes global daily energy spectrum shows the spectral manifestations of solar system planets gravitational resonances. In given article the researches results of natural disasters cosmogenic sources power allow us to argue that ecological risk effective management is impossible without the evolution forecast of the cosmogenic effects intensity on natural processes for sustainable urban development.

1 Introduction

The issue mainstreaming of the environmental risk management effectiveness has received high priority at a high international level [1, 2, 3]. In the US this problem has a half-century history of state regulation [4, 5, 6]. In Russia the environmental risks management is a relevant topic of public policy [7]. In a number of Russian universities textbooks widely presents the main methods of environmental management in the cities and enterprises of the country [8, 9].

* Corresponding author: dpsskmgusu@mail.ru

However in all these documents and textbooks the list of environmental control proposed methods are not considered modern problems of global climate change and the growing intensity of geophysical processes on Earth.

The ecological safety of industrial zones and cities territories largely depends on the fecal and storm sewers stability and buildings and structures of environmentally hazardous industries to natural processes extremal manifestations. Among these processes for most cities in the world include the the geological structures stability violation in the foundations of buildings and underground engineering structures.

Among them the most dangerous are the karsts collapse and landslides in seismoactive areas as a result of the geological structures stress state natural growth.

On the other hand, the stability of the foundations is reduced as a result of the increase in the heavy rainfall and floods intensity in many densely populated areas of Europe, Asia and America. These effects are another reason for the implementation of environmental emergencies.

In areas of high seismic activity are the most dangerous earthquakes and their hydrological consequences, such as tsunamis. It is a major tsunami caused an environmental disaster in the area of the Fukushima nuclear plant in Japan.

Environmental risk management in these areas is a major function of the current and perspective planning of urban development.

However, the effectiveness of this activity largely depends on the evolution forecast accuracy of the dangerous natural processes intensity and seismic activity primarily.

To date, however, the earthquakes reliable prediction is an unsolved problem of modern Geophysics. In this regard, definite prospects for the opening by professors V. P. Nikitsky and M. S. Khlystunov cosmogenic mechanisms of earthquake intensity global growth on Earth [10].

Currently construction in seismically active areas faced with a serious problem of powerful earthquakes risk reliable assessment at a urban planning depth (up to 100 years and more).

One of the key tasks of this problem is the need for verification of a poorly known causality of the earthquakes intensity dangerous evolution.

As a first step in solving this problem, the authors examine the analysis and identification of dominant power sources and mechanisms of seismic activity activation on Earth. Among these sources are undoubtedly gravitational perturbations in the near-earth space. To date, however, the world's scientific schools focused on endogenous causes and mechanisms of earthquakes.

This attitude to the problem by Geophysics explain the global capacity of its own heat of the Earth, the processes of heat and mass transfer and thermodeformative in the lithosphere.

However, the authors comparative assessment of energy these processes with energy cosmogenic gravitational perturbations of the Earth proved the fallacy of this approach.

First, from the modern science view point, the concept of the space (mainly solar activity) influence on the Earth's natural processes was formulated in the late 19th and early 20th century in the work of a scientists number from different countries [11,12,13] (Lehrbuch, 1903; Das Werden, 1907; First Report, 1926).

A comprehensive approach and interdisciplinary formulation of natural disasters and catastrophes cosmogenic concept were formulated by honorary member of the USA Sciences Academy, the Russian scientist Czyzewskiy A. L. [14].

Despite the scientists assumptions in the early twentieth century about the gravitational effects of the solar system planets movement to solar activity, and other evolutionary processes in all Earth spheres (atmosphere, hydrosphere, lithosphere, biosphere, society and

other spheres of the Earth) this mechanism still remains one of the little-studied problems in the Cosmo-terrestrial relations field.

This problem stems from the fact that unexplained fluctuations in cycles of the climatic and geophysical processes intensity variations on Earth did not correspond to the stable orbital periods of gravitational perturbations in the solar system space.

The special interest of the Hlystunov's scientific school to this problem has arisen in connection with the unique result of this schools research in the orbital microgravity field and the theoretical opening in 1992, the radial gravodynamic resonances orbital space objects [10].

This discovery helped to explain the cause of gravitational perturbations instability cycles and the corresponding oscillation periods of the Geosphere processes intensity variations. Individual research results of the author's discoveries with colleagues on this topic have been published in a articles series dedicated to the total influence of orbital and resonant gravitational disturbances in near-earth space environment on the global meteorological and seismic processes evolution.

2 Radial Gravodynamic Resonance of Space Objects

After centuries of oblivion, the first step for the cosmogenic gravitational concept further development has resulted in the opening by the Russian scientists [professor Hlystunov M.S. and professor Nikitskiy V.P.[10] phenomena of orbital objects radial gravitational resonance and its impact on the natural disasters and natural catastrophes intensity evolution.

According to the formula of discovery when the excitation of the orbital object radial gravitational resonance on its orbital motion will be imposed radial resonant oscillations with an amplitude of A_{gr} .

Schematically this movement for a perfectly circular orbit (orbit radius R_{orb}), without considering the effect of the the angular momentum conservation law (assuming that the mass of the Central object M_g significantly less than the mass m_s of the satellite $M_g \gg m_s$, and the satellite radius r_s is significantly less than the radius R_g of the Central object ($r_s \ll R_g \ll R_{orb}$) will appear, as shown in Figure 1. The resonant motion phase dependence from a time is equal $\varphi_{gr} = 2\pi t / T_{gr}$.

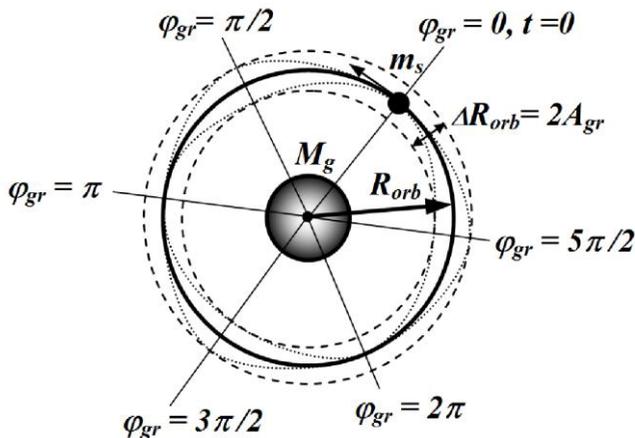


Fig. 1. Schematic representation of the resonant oscillations of the satellite (the planet) relative path in the form of the unperturbed circular orbit.

The opening formula of these resonances was first published by the authors in the International Aerospace Congress IAC'94 theses in August 1994 in the following terms: "Orbital object revolving around the center of gravitational attraction, has a radial gravodynamic resonance whose period is approximately equal to 2/3 of the period of his conversion" [10].

In the future, the hypothesis and the radial gravodynamic resonance theory have been verified by the authors of the discovery from data on the orbital flight trajectory height variations of the geodetic satellite «Topex-Poceidon» and satellite «GEO_IK».

Along with this was established the surprising fact that the radial gravodynamic resonance period, for example, at the sea level height should be 1 hour.

Attempts to find historical sources introduction in practice of such units (1 hour) have been unsuccessful. It should be noted that the satellites radial vibrations relative to the classical orbit was an imposing classical orbital motion, radial resonance frequency and this movement phase modulation result from the action of the angular momentum conservation law when changing the orbit radius by these resonant oscillations.

3 The Parameters of the Orbital and Resonant Gravitational Perturbation

The amplitude evaluation results of the planets and Sun orbital gravitational perturbations energy E_{orb} and the solar system planets radial gravodynamic resonances mid-frequency calculations (in accordance with the formula-opening) are shown in table 1.

Considering most powerful catastrophic Geosphere processes (endogenous and exogenous- cosmogenic), the authors drew attention to a very important fact. All major endogenous and exogenous processes of heat and mass transfer are realized due to the presence of the gravitational field or the direct action result of its perturbations.

Table 1. The spectral parameters of the orbital and resonance gravitational perturbations.

Sources of disturbance	The parameters of the perturbation *				
	F_{orb} , [Hz]	T_{orb} , [day]	F_{gr} , [Hz]	T_{gr} , [day]	E_{orb} , [J/kg]
Moon	4.25 E-7	27.32	6.01E-7	19.32	-
Mercury	1.32 E-7	87.97	1.87E-7	62.2	-
Venus	5.165 E-8	224.7	7.3E-8	158.9	6.1E33
Earth	3.177E-8	365.2	4.49E-8	258.3	5.55E33
Mars	1.69E-8	686.7	2.39E-8	485.6	-
Jupiter	2.68E-9	4332	3.79E-9	3063	3.3E35
Saturn	1.079E-9	10760	1.53E-9	7609	5.68E34
Uranium	3.782E-10	30689	5.35E-10	21700	-
Neptune	1.928E-10	60187	2.73E-10	42558	-

Sources of disturbance	The parameters of the perturbation *				
	F_{orb} , [Hz]	T_{orb} , [day]	F_{gr} , [Hz]	T_{gr} , [day]	E_{orb} , [J/kg]
Pluto	1.281E-10	90616	1.81E-10	64075	-
*Where F_{orb} , T_{orb} , F_{gr} , T_{gr} , E_{orb} – respectively, the frequency and period of the orbital motion, the frequency and period of the radial gravodynamic resonance, the specific orbital energy of the Sun gravitational perturbations					

A comparison of the cosmogenic gravitational perturbations energy distribution average density in the Earth's geospheres confirms their dominant role compared with the endogenous component (see table 2).

The gravitational interaction energy density of the Earth with the objects in the solar system and the Moon by several orders of magnitude higher than the solar radiation average energy density and its own heat of the Earth.

Table 2. The comparative energy parameters of the geospheres cosmogenic perturbations.

Sources of disturbance	The parameters of the perturbations*		
	E_g/E_{sr} , [r.u. / year]	E_g/E_{gt} , [r.u. / year]	Q_g/Q_{sr} , [r.u. / year]
Sun	1.0E+09	8.3E+12	1.81E+07
Moon	1.85E+05	1.52E+09	1.03E+04
Mercury	2.36E+02	1.96E+06	1.22E+02
Venus	9.02E+03	7.48E+07	7.56E+03
Mars	6.18E+02	5.13E+06	5.21E+02
Jupiter	2.27E+05	1.89E+09	7.38E+04
Saturn	3.27E+04	2.71E+08	6.41E+03
Uranium	2.36E+03	1.96E+07	2.39E+02
Neptune	1.78E+03	1.48E+07	1.09E+02
Pluto	1.31E-02	1.09E+02	6.41E-03
*Where E_g/E_{sr} , E_g/E_{gt} , Q_g/Q_{sr} – respectively, the amplitude variations ratio of the geospheres perturbation gravitational energy to the solar irradiation, the ratio of the geospheres perturbation gravitational energy amplitude variations to own energy dissipation of the Earth, the ratio of the geospheres gravitational energy density perturbations variations amplitude to the specific energy of the solar radiation (on a 1 kg mass of the Earth during the variations period).			

The calculations for this table is made only taking into account the eccentricity of the solar system planets the around the Sun.

In this regard, particular interest to the authors of the opening was the planets resonant vibrations influence on the Geosphere processes under the gravitational perturbations action, for example, caused by the Shoemakers-Levy's comet fall on Jupiter in July 1994.

According to preliminary estimates, the hydrogen bomb "father" Edward teller, when the comet collision with Jupiter the released energy, which is equivalent to energy blast 10 billion megatons of TNT, or a hundred million explosion energy of the Tunguska meteorite ($2.77 \cdot 10^{22}$ to $4.61 \cdot 10^{25}$ J).

The resulting energy of the Jupiter gravitational perturbations can be much more solar irradiation of the Earth for a year.

The self-heat generation energy of the Earth for the year will be over five orders of magnitude lower than the Jupiter gravitational perturbations energy.

In this regard, it can be assumed that the comet explosion on Jupiter may have a significant impact on the intensity of seismic, volcanic and meteorological processes on Earth.

In this article, we will consider the global analysis results of the seismic activity evolution on Earth in the period before and after the collision of Shoemakers-Levy's comet on Jupiter.

For example, use of data on global seismic activity on Earth in length 1024 days.

The original data were represented by the earthquakes magnitudes more than 2.5 points on the Richter scale. The array primary analysis showed that the number of such seismic events and their daily energy increased considerably after the fall of the Shoemakers-Levy's comet on Jupiter.

Figure 2 shows the amplitude (a) and spectrum (b) variation of earthquakes daily energy on the Earth for a period of 2.8 years. Normalization of daily energy earthquakes curve was performed by the maximum value in the array.

4 Spectrum Analysis of Seismic Activity Daily Variations on Earth

As the array length is only 1024 days, and its spectrum is clearly observed only the gravitational perturbations manifestations of Mercury, Venus, Earth and Mars, as well as their combined harmonics. The background spectrum below 1% of the maximum amplitude in Figure 3b are not shown, since it had no resonance or cyclic manifestations and do not present opportunities for correct analytical conclusions. A comparative analysis of the spectrum and fundamental frequencies and combined harmonics of the gravitational perturbations in the near-earth space according to the data of table 1 reveals the following coincidence frequencies of the dominant resonant manifestations in the spectrum:

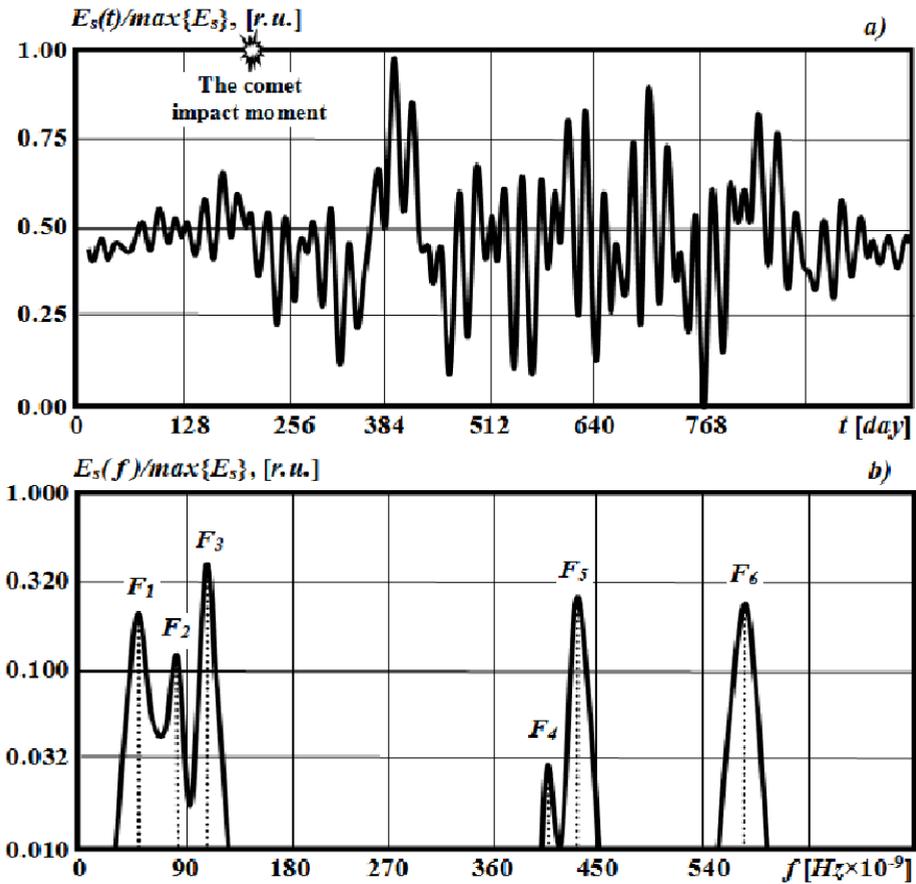


Fig. 2. The normalized amplitude and the spectrum of earthquakes daily energy variation in the period from 01.01.1994 on 19.09.1996:

- $F_1=5.16 \cdot 10^{-8}$ equal to the frequency of Venus circulation around the Sun;
- $F_2=8.04 \cdot 10^{-8}$ equal to the frequencies difference of Venus and Mercury circulations;
- $F_3=1.08 \cdot 10^{-7}$ equal to the frequencies difference of the Mars radial gravodynamic resonance and the orbital circulation frequency of Mercury. In the frequency band of this peak is also the frequencies difference harmonic of radial gravodynamic resonances of Venus and Mercury, the frequencies sums harmonic of the Earth circulation and radial gravodynamic resonance of Venus, the second harmonic of the Venus orbital circulation around the Sun;
- $F_4=3.90 \cdot 10^{-7}$ equal to the frequencies difference of radial gravodynamic resonance of the Earth and the Moon circulation around the Earth, but also in the frequency band peak of this resonance is the frequencies difference harmonic of the Moon circulation around the Earth and the Earth circulation around the Sun;
- $F_5=4.50 \cdot 10^{-7}$ equal to the frequencies sum of the Mars radial gravodynamic resonance and the Moon circulation around the Earth, the speed of the layers of the Sun near the equator;
- $F_6=5.50 \cdot 10^{-7}$ equal to the synodic period of the Moon circulation around the Earth, the frequencies difference of the Moon radial gravodynamic resonance and Venus circulation around the Sun.

5 Conclusion

The research considering results of natural disasters cosmogenic sources power allow us to argue that ecological risk effective management is impossible without the evolution forecast of the cosmogenic effects intensity on natural processes for the urban planning period. Critical issue of environmental risk management in urban areas is to predict the evolution of the dangerous natural processes intensity. The special situation in the realization of these risks take the earthquake threat and emergency fluctuations in the stresses in the geological environment of the buildings and structures bases. The studies results of the radial gravodynamic resonances and the solar system planets around the Sun on the evolution of the geophysical processes intensity on Earth allow to draw the following conclusions.

1. A comparative power analysis of endogenous and cosmogenic sources of geospheres excitation showed that the Earth cosmogenic gravitational perturbations power by several orders of magnitude higher than the total capacity of own heat and sun exposure of the Earth, and the technosphere power, including the military.

2. The variations analysis of the earthquakes daily energy on the Earth before and after the Shoemakers-Levy's comet explosion on Jupiter showed that the number of seismic events on Earth with a magnitude of more than 2.5 points after the comet explosion increased in 10 times. This fact confirms the dominant gravitational influence presence of the Cosmo-terrestrial relations on the Earth seismic activity.

3. Reliable the intensity evolution prediction of natural disasters and natural catastrophes on Earth cannot be implemented without taking into account the effect, as the orbital gravitational perturbations and perturbations caused by the radial gravodynamic resonances excitation of the solar system planets, the Earth and the Moon.\

The results of this study can be useful for the natural risks assessment on the long term development of urbanized territories [15] in an era of global climate change [16] and growth activity of geophysical processes.

References

1. Rio Declaration on Environment and Development.-UN: A/CONF.151/26/Rev.1, I, 3–7 (1992)
2. *Ekologicheskiy uchet dlya predpriyatiy, Konferentsiya OON potorgovle i razvitiyu* (Finansyi statistika, Moscow, 1997)
3. *Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage*
4. *Comprehensive environmental response, compensation and liability act (CERCLA)* (USA, 1980)
5. *National Environmental Policy Act (NEPA)* (Washington, 1970)
6. *Environmental Quality. The Twenty-Second Annual Report of the Council on Environmental Quality together with The President's Message to Congress* (Washington, 1992)
7. *Gosudarstvennyy doklad «O sostoyanii okruzhayushchey sredy Rossiyskoy Federatsii v 2006 godu»* (Moscow, 2007)
8. R.S. Permyakov *Ekonomicheskiy mekhanizm ekologicheskogo menedzhmenta. Lektsii* (Izd-vo Rossiyskoy Akademii Gosudarstvennoy Sluzhby, Moscow 1998)
9. S.N. Bobylev *Ekologizatsiya ekonomicheskogo razvitiya: Uchebnoe posobie* (Izd-vo MGU im. M.V. Lomonosova, Moscow, 1993)
10. M.S. Khlystunov, V.P. Nikitskiy. *International Aerospace Congress*, 225-226 (1994)

11. *Lehrbuch der kosmischen Physik* (Leipzig, 1903)
12. Das Werden der Welten. Ueb. von L. Bamberger L. (1907)
13. *First Report of the Commission appointed to further the study of solar and terrestrial relationships* (Paris, 1926)
14. A.L. Chizhevskiy. *Zemnoe eho solnechnyih bur* (Izdatelstvo «Myisl», 1976) ISBN 978-5-517-92874-0
15. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation Special Report of the Intergovernmental Panel on Climate Change* (UK: Cambridge University Press, 2012)
16. *Climate Change 2013. The Physical Science Basis/Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (UK: Cambridge University Press, 2013)