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# The Thermohydrogravidynamic Theory Concerning the First Forthcoming Subrange 2020 ÷ 2026 AD of the Increased Intensification of the Earth

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**Abstract.** The article presents the subsequent development of the established thermohydrogravidynamic theory (intended for deterministic prediction of the temporal intensifications of the global and regional seismotectonic, volcanic and climatic activity of the Earth) based on the author's generalized differential formulation of the first law of thermodynamics extending the classical Gibbs' formulation by taking into account (along with the classical infinitesimal change of heat $\delta Q$ and the classical infinitesimal change of the internal thermal energy $dU_\tau$) the established differential energy gravitational influence $dG$ (due to the cosmic and terrestrial non-stationary gravitation) on the continuum region $\tau$ along with the established differential increment $dK_\tau$ of the macroscopic kinetic energy, the established differential increment $d\Pi_\tau$ of the gravitational potential energy and the established generalized expression for the differential work $\delta A_{np,\partial\tau}$ done by the non-potential terrestrial stress forces (determined by the symmetric stress tensor $\boldsymbol{T}$) acting on the boundary surface $\partial_\tau$ of the individual finite continuum region $\tau$ subjected to the non-stationary Newtonian gravitation. Taking into account the combined solar and planetary integral energy gravitational influence of the internal rigid core $\tau_{c,r}$ of the Earth $\tau_3$ during the considered range (2004 ÷ 2026) AD, the author presents (on May 30, 2018) the foundation (based on the established and confirmed global prediction thermohydrogravidynamic principles determining the strongest temporal intensifications of the global and regional seismotectonic, volcanic and climatic activity of the Earth) of the established first forthcoming subrange (2020 ÷ 2026) AD of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth related with the maximal (near $t^*(\tau_{c,r}, 2021)=2021.1$ AD)) and the minimal (near $t_*(\tau_{c,r}, 2021)=2021.65$ AD)) combined cosmic (planetary and solar) integral energy gravitational influences on the internal rigid core of the Earth.

**Keywords:** Thermohydrogravidynamic theory, generalized formulation of the first law of thermodynamics, non-stationary cosmic gravitation, global seismicity, global volcanic and climatic activity, natural disasters of the Earth.

## 1 Introduction

The problem of the long-term predictions of the strong earthquakes [1] is the significant problem of the modern geophysics [2]. It is well known that "the deterministic prediction of the time of origin, hypocentral (or epicentral) location, and magnitude of an impending earthquake is an open scientific problem" [2]. It was conjectured [2] that the possible earthquake prediction and warning must be carried out on a deterministic basis. However, it was pointed out [2] with some regret that the modern "study of the physical conditions that give rise to an earthquake and the processes that precede a seismic rupture of an ordinary event are at a very preliminary stage and, consequently, the techniques of prediction of time of origin, epicentre, and magnitude of an impending earthquake now available are below standard". In the special issue [3] of the International Journal of Geophysics, Rodolfo Console, Koshun Yamaoka, and Jiancang Zhuang assessed the status of the art of earthquake forecasts and their applicability. It was conjectured [3] that the recent destructive earthquakes occurred in Sichuan (China, 2008), Italy (2009), Haiti (2010), Chile (2010), New Zealand (2010), and Japan (2011) "have shown that, in present state, scientific researchers have achieved little or almost nothing in the implementation of short- and medium-term earthquake prediction, which would be useful for disaster mitigation measures".

In this article, the author presents to the New Horizons in Mathematical Physics the fundamentals of the thermohydrogravidynamic theory, which can be considered as the new horizon in cosmic and mathematical physics intended for deterministic prediction of the strongest intensifications of the global seismotectonic, volcanic and climatic activity induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, Mercury, Venus, Mars, Jupiter and the Sun (owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune). The thermohydrogravidynamic theory is based on the established [4-8] equivalent generalized differential formulations (10), (17) and (19) of the first law of thermodynamics (for moving rotating deforming compressible heat-conducting stratified individual finite continuum region $\tau$ subjected to the non-stationary Newtonian gravitational field) extending the classical formulation [9] by taking into account (along with the classical infinitesimal change of heat $\delta Q$ [9] and the classical infinitesimal change of the internal energy $dU_\tau$ [9]) the established [5, 6] significant differential (infinitesimal) energy gravitational influence $dG$ (as the result of the Newtonian non-stationary cosmic and terrestrial gravitation) on the individual finite continuum region $\tau$ during the infinitesimal time interval $dt$. The significance of the established [5, 6] differential (infinitesimal) energy gravitational influence dG (as the result of the Newtonian non-stationary cosmic and terrestrial gravitation) is confirmed by noticeable variations of gravitational field identified [10,11] before strong earthquakes in China from 2001 to 2008. It was pointed out [10] that the gravity changes (derived from regional gravity monitoring data in China from 1998 to 2005) exhibited noticeable variations before the occurrence of two large earthquakes in 2008 in the areas surrounding Yutian (Xinjiang) and Wenchuan (Sichian). It was pointed out [11] that significant gravity changes were observed before all nine large earthquakes that ruptured within or near mainland China from 2001 to 2008. It was concluded [10] that the past experience and empirical data showed that “earthquakes typically occur within one to two years after a period of significant gravity changes in the region in question”. The necessity to consider the gravitational field (during the strong earthquakes) is also related with the observations of the slow gravitational [12, 13] ground waves resulting from strong earthquakes and spreading out from the focal regions [14, 15] of earthquakes. Lomnitz pointed out [14] that the gravitational ground waves (related with great earthquakes) “have been regularly reported for many years and remain a controversial subject in earthquake seismology”. Richter presented [1] the detailed analysis of these observations and made the conclusion that “there is almost certainly a real phenomenon of progressing or standing waves seen on soft ground in the meizoseismal areas of great earthquakes”. The fundamental connections of the geodynamics, seismicity and volcanism with gravitation (and the slow gravitational ground waves resulting from strong earthquakes) are presented in the works [16, 17]. Based on the established [5, 6] generalized differential formulation of the first law of thermodynamics, the author explained [18] the founded cosmic energy gravitational genesis of the strong Chinese 2008 [6] and the strong Japanese 2011 [7, 8] earthquakes.

Based on the established [5, 6] significant differential (infinitesimal) energy gravitational influence dG (as the result of the Newtonian non-stationary cosmic gravitation) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the individual finite continuum region $\tau$) during the infinitesimal time interval dt, we established [19, 20] the rigorous global and local (for the individual finite continuum region $\tau$) prediction thermohydrogravidynamic principles determining the maximal temporal intensifications of the established [19, 20] thermohydrogravidynamic processes (in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth, and in the Earth as a whole; in the individual finite continuum region $\tau$) and related global and regional natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth.

Based on the rigorous global prediction thermohydrogravidynamic principle (134), we established the first confirmed validity [21] of the thermohydrogravidynamic theory concerning the predicted (on 31 August, 2016 [21] based on the real planetary configurations of the Earth and the planets of the Solar System) strongest intensifications of the global natural processes of the Earth in 2016 since 1 September, 2016 and before 26 January, 2017. The article [21] presented the first confirmed validity of the established global prediction thermohydrogravidynamic principle (134) (of the developed thermohydrogravidynamic theory containing the cosmic geophysics and the cosmic seismology based on the generalization (19) of the first law of thermodynamics for non-stationary cosmic gravitation) concerning the predicted (in advance, on 31 August, 2016 [21]) strongest intensifications (in 2016 since 1 September, 2016 and before 26 January, 2017) of the global seismotectonic, volcanic, climatic and magnetic processes of the Earth determined by the maximal combined integral energy gravitational influence (realized approximately on 6 October, 2016) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. We can present the first established [21] unquestionable fact (from the all presented facts [21]) that the date of 6 October, 2016 (when "Hurricane Matthew has gained new muscle over the Bahamas" [22]) is in the perfect agreement with the calculated (in advance, on 31 August, 2016) numerical time moment $t^*(\tau_{c,r}, 2016) = 2016.7666$ AD (corresponding approximately to 6 October, 2016) of the maximal (in 2016) combined planetary and solar integral energy gravitational influence (134) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole). Based on the rigorous global prediction thermohydrogravidynamic principle (135), we established [23] the second confirmed validity of the thermohydrogravidynamic theory concerning the first subrange of the strongest intensifications of the global natural processes of the Earth in 2017 since 10 April, 2017 and before 6 August, 2017. The article [23] confirmed the validity of the established prognostications (made on 10 April, 2017 and on 16 July, 2016 based on the global prediction thermohydrogravidynamic principle (135) and on the real planetary configurations of the Earth and the planets of the Solar System) concerning the first subrange of the strongest (in 2017) intensifications of the global natural (seismotectonic, volcanic and climatic) processes of the Earth (since 10 April, 2017 and before 6 August, 2017) determined by the minimal (near the calculated numerical time moment $t_*(\tau_{c,r}, 2017) = 2017.3$ AD corresponding approximately to 20 April, 2017) combined integral energy gravitational influence on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. Based on the rigorous global prediction thermohydrogravidynamic principle (134), we established [24] the third confirmed validity of the predictions [25, 26] of the thermohydrogravidynamic theory concerning the strongest intensifications of the seismotectonic and climatic processes in California (since 9 August, 2017 and before 3 March, 2018 [25]) and in Japan since 24 July, 2017 and before 16 March, 2018 [26]. The article [24] presented (on November 11, 2017) the confirmed validity of the predictions (made on August 9, 2017 [25, 26] based on the real planetary configurations of the Earth and the planets of the Solar System) of the established global prediction thermohydrogravidynamic principle (134) (of the developed thermohydrogravidynamic theory based on the generalization (19) of the first law of thermodynamics for non-stationary cosmic gravitation) concerning the strongest intensifications of the seismotectonic and climatic processes in California (since 9 August, 2017 and before 3 March, 2018 [25]) and in Japan (since 24 July, 2017 and before 16 March, 2018 [26]) determined by the maximal (near the calculated numerical time moment $t^*(\tau_{c,r}, 2017) = 2017.85$ AD corresponding approximately to 7 November, 2017) combined integral energy gravitational influence on the internal rigid core of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. We concluded [24] that the confirmed (on November 11, 2017) validity of the made (on August 9, 2017 [25, 26]) predictions means the validity of the cosmic energy gravitational genesis (related with the combined integral energy gravitational influence on the internal rigid core $\tau_{c,r}$ of the Earth of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune) of the predicted (on August 9, 2017 [25, 26]) modern strongest (in 2017) intensifications of the seismotectonic and climatic processes in California and Japan determined by the established thermohydrogravidynamic processes [19, 20] in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth subjected to the combined cosmic (planetary, solar and lunar) energy gravitational influence. Finally, based on the rigorous global prediction thermohydrogravidynamic principles (134) and (135), we presented [27] the confirmed validity of the cosmic energy gravitational genesis of the strongest Japanese, Italian, Greek, Chinese and Chilean earthquakes. The article [27] presented (on February 13, 2018) the confirmed validity of the cosmic energy gravitational genesis of the strongest Japanese (for 2015 and 2016), Italian (for 2016), Greek (for 2017), Chinese (for 2008 and 2017) and Chilean (for 2015 and 2016) earthquakes related with the extreme (maximal and minimal, respectively) combined integral energy gravitational influences (in accordance with the established [19, 20] global prediction thermohydrogravidynamic principles (134) and (135) of the cosmic seismology) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. We established [27] that the first direct detection of gravitational waves (on September 14, 2015 [28, 29]) is located between the calculated (based on the real planetary configurations of the Earth and the planets of the Solar System) date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD (corresponding approximately to September 6, 2015 of the maximal (in 2015) combined planetary and solar integral energy gravitational influence on the internal rigid core of the Earth) and the date (September 16, 2015 according to the U.S. Geological Survey) of the strongest (in 2015 according to the U.S. Geological Survey) 8.3-magnitude Chilean earthquake (realized near 10 days after the date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD calculated based on the real planetary configurations of the Earth and the planets of the Solar System).

In this article, following the "Statistical thermohydrodynamics of irreversible strike-slip-rotational processes" [5] and the "Thermohydrogravidynamics of the Solar System" [6], in Subsection 2 we present the established [5, 6] equivalent generalized differential formulations (10), (17) and (19) of the first law of thermodynamics (for moving rotating deforming compressible heat-conducting stratified individual finite continuum region $\tau$ subjected to the non-stationary Newtonian gravitational field) extending the classical formulation [9] by taking into account (along with the classical infinitesimal change of heat $\delta Q$ and the classical infinitesimal change of the internal energy $dU_\tau$) the infinitesimal increment $dK_\tau$ of the macroscopic kinetic energy $K_\tau$, the infinitesimal increment $d\Pi_\tau$ of the gravitational potential energy $\Pi_\tau$, the generalized expression for the infinitesimal work $\delta A_{np,\partial\tau}$ done by the non-potential terrestrial stress forces (determined by the symmetric stress tensor $\mathbf{T}$) acting on the boundary surface $\partial\tau$ of the continuum region $\tau$, and the established [5, 6] differential (infinitesimal) energy gravitational influence dG (as the result of the Newtonian non-stationary cosmic and terrestrial gravitation) on the individual finite continuum region $\tau$ during the infinitesimal time interval dt.

In Section 3 we present the fundamentals of the thermohydrogravidynamic theory related with the increased intensifications of the global seismotectonic, volcanic and climatic activity of the Earth. In Section 3.1 we present the established foundation [19] of the energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune) of the Solar System. In Section 3.1.1 we present the established [19] evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune) of the Solar System. In Section 3.1.2 we present the established [19] evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the planets of the Solar System. In Section 3.1.3 we present the established [18, 19] evidence that the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$ and Saturn $\tau_6$) and the Moon is the predominant cosmic trigger mechanism of earthquakes prepared by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$ and Neptune $\tau_8$), Venus, Jupiter, the Moon, Mars and Mercury.

In Section 3.2 we present the established [19, 20] catastrophic planetary configurations (of the cosmic geophysics and the cosmic seismology) related with the maximal and minimal combined integral energy gravitational influence on the Earth $\tau_3$ of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$ and Neptune $\tau_8$) and the planets of the Solar System.

In Section 3.3 we present the established [19, 20] cosmic energy gravitational genesis of the global seismotectonic, volcanic and climatic activity of the Earth induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun (owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune). In Section 3.3.1 we present the established [19] time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune). In Section 3.3.2 we present the established [19, 20] fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic, volcanic and climatic activity induced by the different combinations of the cosmic non-stationary energy gravitational influences of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune.

In Section 4 we present the founded confirmation of the thermohydrogravidynamic theory concerning the validity of the previously established [19, 20] first forthcoming subrange (2023±3) AD of the increased global seismotectonic, volcanic and climatic activity of the Earth. In Section 4.1 we present the established [19] linkage of the greatest earthquake destroyed the ancient Pontus (63 BC [30]) and the great earthquakes [16] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD) and Portugal (1320 AD and 1344 AD). In Section 4.2 we present the established [19] linkage of the planetary disasters occurred in the Central Asia (10555 BC [31]) and in the ancient Egyptian Kingdom (10450 BC [32]), and the greatest earthquake destroyed the ancient Pontus (63 BC [30]). In Section 4.3 we present the foundation of the established [19, 20] first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic and climatic activity of the Earth. In Section 4.4 we present the foundation of the established forthcoming dates $\mathrm{t}^*(\tau_{\mathrm{c,r}}, 2021) = 2021.1$ AD and $\mathrm{t}_*(\tau_{\mathrm{c,r}}, 2021) = 2021.65$ AD corresponding to the maximal and minimal (respectively) combined planetary and solar integral energy gravitational influences on the internal rigid core of the Earth during the established [19, 20] first forthcoming subrange (2020÷2026) AD of the increased intensification of the global seismotectonic, volcanic and climatic activity of the Earth. In Section 4.5 we present the evaluation of the maximal magnitudes of the strongest earthquakes of the Earth during the first established forthcoming subrange (2020÷2026) AD of the increased intensification of the global seismotectonic, volcanic and climatic activity of the Earth.

In Section 5 we present the summary of main results and conclusion.

## 2 The Generalized Differential Formulation of the First Law of Thermodynamics for Non-stationary Newtonian Gravitational Field

Considering the graphical methods in the thermodynamics of fluids, Gibbs [9] formulated the first law of thermodynamics for the fluid body (fluid region) as follows (in Gibbs' designations):

$$\mathrm{d}\varepsilon = \mathrm{dH} - \mathrm{dW}, \tag{1}$$

where dε is the differential of the internal thermal energy of the fluid body, dH is the differential change of heat across the boundary of the fluid body related with the thermal molecular conductivity (associated with the corresponding external or internal heat fluxes), dW=pdV is the differential work produced by the considered fluid body on its surroundings (surrounding fluid) under the differential change dV of the fluid region (of volume V) characterized by the thermodynamic pressure p.

The formulation [33] of the first law of thermodynamics for the general thermodynamic system (material region) is given by the equivalent form (in Landau's and Lifshitz's designations [33]):

$$\mathrm{dE} = \mathrm{dQ}\text{-}\mathrm{pdV}, \tag{2}$$

where dA=−pdV is the differential work produced by the surroundings (surroundings of the thermodynamic system) on the thermodynamic system under the differential change dV of volume V of the thermodynamic system characterized by the thermodynamic pressure p; dQ is the differential heat transfer (across the boundary of the thermodynamic system) related with the thermal interaction of the thermodynamic system and the surroundings (surrounding environment); E is the energy of the thermodynamic system, which should contain (as supposed [33]) the kinetic energy of the macroscopic continuum motion.

Following the works [4-8, 18-21, 23-27], we shall present the foundation of the generalized differential formulation of the first law of thermodynamics (in the Galilean frame of reference) for non-equilibrium shear-rotational states of the one-component deformed individual finite continuum region τ (characterized by the symmetric [34, 35] stress tensor **T**) moving in the non-stationary Newtonian gravitational field. We shall consider the one-component deformed individual finite continuum region in non-equilibrium shear-rotational states. We shall assume that τ is an individual finite continuum region bounded by the closed continual boundary surface ∂τ considered in the three-dimensional Euclidean space with respect to a Cartesian coordinate system *K*. We shall consider the individual finite continuum region τ in a Galilean frame of reference with respect to a Cartesian coordinate system *K* centred at the origin O and determined by the axes $X_1$, $X_2$, $X_3$ (see Fig. 1). The unit normal *K*-basis coordinate vectors triad $\boldsymbol{\mu}_1$, $\boldsymbol{\mu}_2$, $\boldsymbol{\mu}_3$ is taken in the directions of the axes $X_1$, $X_2$, $X_3$, respectively. The *K*-basis vector triad is taken to be right-handed in the order $\boldsymbol{\mu}_1$, $\boldsymbol{\mu}_2$, $\boldsymbol{\mu}_3$, see Fig. 1.

 

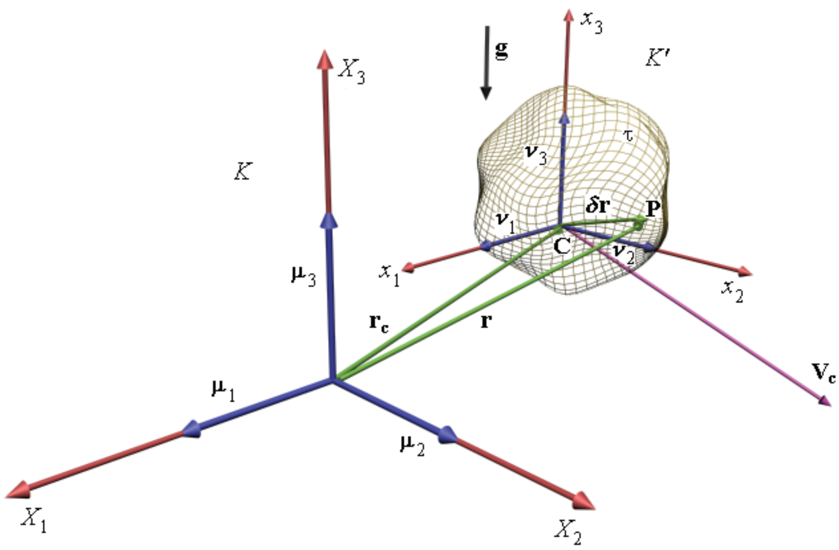


**Figure 1.** Cartesian coordinate system $K$ of a Galilean frame of reference and the individual finite continuum region mass center-affixed Lagrangian coordinate system $K'$

An arbitrary point $\mathbf{P}$ in three-dimensional physical space will be uniquely defined by the position-vector $\mathbf{r}=X_i\boldsymbol{\mu}_i\equiv(X_1, X_2, X_3)$ originating at the point O and terminating at the point $\mathbf{P}$. The continuum region-affixed Lagrangian coordinate system $K'$ (with the axes $x_1$, $x_2$, $x_3$) is centered to the mass center C of the individual finite continuum region $\tau$. The axes $x_1$, $x_2$, $x_3$ are taken parallel to the axes $X_1$, $X_2$, $X_3$, respectively: the axis $x_i$ is parallel to the axis $X_i$, where i = 1, 2, 3. The unit normal $K'$-basis coordinate vector triad $\boldsymbol{\nu}_1$, $\boldsymbol{\nu}_2$, $\boldsymbol{\nu}_3$ is taken in the directions of the axes $x_1$, $x_2$, $x_3$, respectively. The $K'$-basis vector triad is taken to be right-handed in the order $\boldsymbol{\nu}_1$, $\boldsymbol{\nu}_2$, $\boldsymbol{\nu}_3$ The mathematical differential of the position-vector $\mathbf{r}$, $\delta\mathbf{r}\equiv x_i\boldsymbol{\nu}_i\equiv(x_1, x_2, x_3)$ expressed in terms of the coordinates $x_i$ (i = 1, 2, 3) in the $K'$- coordinate system, originates at the mass centre C of the individual finite continuum region $\tau$ and terminates at the arbitrary point P of the individual finite continuum region $\tau$. $\mathbf{g}=\mathbf{g}(\mathbf{r},t)$ is the local gravity acceleration considered as a vector function [34, 35] of variables $\mathbf{r}$ and the time t.

The position-vector $\mathbf{r}_c$ of the mass center C of the individual finite continuum region $\tau$ in the $K$-coordinate system is given by the following expression

$$\mathbf{r_c} = \frac{1}{m_\tau}\iiint_\tau \mathbf{r}\rho \, dV, \tag{3}$$

where

$$m_\tau = \iiint_\tau \rho \, dV \tag{4}$$

is the mass of the individual finite continuum region $\tau$, dV is the mathematical differential of the physical volume of the individual finite continuum region $\tau$, $\rho\equiv\rho(\mathbf{r},t)$ is the local macroscopic density of mass distribution, $\mathbf{r}$ is the position-vector of the continuum volume dV. The speed of the mass centre C of the individual finite continuum region $\tau$ is defined by the following expression

$$\mathbf{V}_c = \frac{d\mathbf{r_c}}{dt} = \frac{\iiint_\tau \mathbf{v}\rho \, dV}{m_\tau}, \tag{5}$$

where $\mathbf{v} = \dfrac{d\mathbf{r}}{dt}$ is the hydrodynamic velocity vector, the operator $d/dt=\partial/\partial t+\mathbf{v}\cdot\nabla$ denotes the total derivative [4, 34, 35, 36] following the continuum substance. The relevant three-dimensional fields such as the velocity and the local mass density (and also the first and the second derivatives of the relevant fields) are assumed to vary continuously throughout the entire continuum bulk of the individual finite continuum region $\tau$.

We shall use the differential formulation of the first law of thermodynamics [37] for the specific volume $\vartheta = 1/\rho$ of the one-component deformed continuum with no chemical reactions:

 

$$\frac{du}{dt} = \frac{dq}{dt} - p\frac{d\vartheta}{dt} - \vartheta\Pi\!:\!\mathrm{Grad}\ \mathbf{v}, \tag{6}$$

where u is the specific (per unit mass) internal thermal energy, p is the thermodynamic pressure, $\mathbf{\Pi}$ is the viscous-stress tensor, $\mathbf{v}$ is the hydrodynamic velocity of the continuum macrodifferential element [37], dq is the differential change of heat across the boundary of the continuum region (of unit mass) related with the thermal molecular conductivity described by the heat equation [37]:

$$\rho\frac{dq}{dt} = -\mathrm{div}\ \mathbf{J}_q, \tag{7}$$

where $\mathbf{J}_q$ is the heat flux [37]. The viscous-stress tensor $\mathbf{\Pi}$ is taken from the decomposition $\mathbf{P}=p\boldsymbol{\delta}+\mathbf{\Pi}$ of the pressure tensor $\mathbf{P}$ [37], where $\boldsymbol{\delta}$ is the Kronecker delta-tensor. The macroscopic local mass density ρ of mass distribution and the local hydrodynamic velocity $\mathbf{v}$ of the macroscopic velocity field are determined by the classical hydrodynamic continuity equation [35, 36, 38]:

$$\frac{\partial\rho}{\partial t} + \mathrm{div}(\rho\ \mathbf{v}) = 0 \tag{8}$$

under the absence of distributed space-time sources of mass output.

Using the differential formulation (6) of the first law of thermodynamics [37] for the total derivative du/dt (following the continuum substance) of the specific (per unit mass) internal thermal energy u of the one-component deformed continuum with no chemical reactions, the heat equation (7) [37], the decomposition $\mathbf{P}=p\boldsymbol{\delta}+\mathbf{\Pi}$ of the pressure tensor $\mathbf{P}$, the hydrodynamic continuity equation (8), and the general equation of continuum movement [35, 38]:

$$\frac{d\mathbf{v}}{dt} = \frac{1}{\rho}\mathrm{div}\ \mathbf{T}+\mathbf{g} \tag{9}$$

for the deformed continuum characterized by the symmetric [34, 35] stress tensor $\mathbf{T}=-\mathbf{P}$ [38] of a general form and taking into account the time variations of the potential $\psi$ of the non-stationary gravitational field (characterized by the local gravity acceleration vector $\mathbf{g} = -\nabla\psi$ ) inside of the individual finite continuum region τ, we derived [5, 6] the generalized differential formulation (for the Galilean frame of reference) of the first law of thermodynamics (for moving rotating deforming heat-conducting stratified individual finite one-component continuum region $\tau$ subjected to the non-stationary Newtonian gravitational field and to non-potential stress forces characterized by the symmetric [34, 35, 38] stress tensor $\mathbf{T}$ of a general form):

$$d(K_\tau + U_\tau + \Pi_\tau) = dt\iint_{\partial\tau}\left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right)d\Omega_\mathbf{n} - dt\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_\mathbf{n} + dt\iiint_\tau\frac{\partial\psi}{\partial t}\rho\ dV, \tag{10}$$

where

$$\delta A_{np,\partial\tau} = dt\iint_{\partial\tau}\left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right)d\Omega_\mathbf{n} \tag{11}$$

is the differential work done during the infinitesimal time interval dt by non-potential stress forces (pressure, compressible and viscous forces for Newtonian continuum) acting on the boundary surface ∂τ of the individual finite continuum region τ; $d\mathbf{\Omega}_n$ is the differential element (of the boundary surface ∂τ of the individual finite continuum region τ) characterized by the external normal unit vector $\mathbf{n}$; $\mathbf{t}=\mathbf{n}\cdot\mathbf{T}$ is the stress vector [38];

$$\delta Q = -dt\iint_{\partial\tau}\left(\mathbf{J}_q\cdot\mathbf{n}\right)d\Omega_\mathbf{n} \tag{12}$$

is the differential change of heat of the individual finite continuum region τ related with the thermal molecular conductivity of heat across the boundary $\partial\tau$ of the individual finite continuum region τ, $\mathbf{J}_q$ is the heat flux [37] (across the element $d\mathbf{\Omega}_n$ of the continuum boundary surface $\partial\tau$);

$$dG = dt\iiint_\tau\frac{\partial\psi}{\partial t}\rho\ dV \tag{13}$$

is the established [5, 6] differential (infinitesimal) energy gravitational influence dG (as the result of the Newtonian non-stationary gravitation) on the individual finite continuum region τ (during the infinitesimal time interval dt);

$$\Pi_\tau = \iiint_\tau\psi\rho\ dV \tag{14}$$

 

is the established [4, 5, 6] macroscopic potential energy (of the individual finite continuum region τ) related with the non-stationary potential $\psi$ of the gravitational field;

$$U_\tau = \iiint_\tau u\rho dV \tag{15}$$

is the classical [4, 5, 6, 9, 39] microscopic internal thermal energy of the individual finite continuum region τ;

$$K_\tau = \iiint_\tau \rho \frac{\mathbf{v}^2}{2} dV \tag{16}$$

is the instantaneous macroscopic kinetic energy of the individual finite continuum region τ.

The generalized differential formulation (10) of the first law of thermodynamics can be rewritten as follows [5, 6, 18, 19]:

$$\begin{aligned} \frac{dE_\tau}{dt} &= \frac{d}{dt}\left(K_\tau + U_\tau + \Pi_\tau\right) = \frac{d}{dt}\iiint_\tau \left(\frac{1}{2}\mathbf{v}^2 + u + \psi\right)\rho\ dV \\ &= \iint_{\partial\tau}\left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right) d\Omega_{\mathbf{n}} - \iint_{\partial\tau}\left(\mathbf{J}_q \cdot \mathbf{n}\right) d\Omega_{\mathbf{n}} + \iiint_\tau \frac{\partial\psi}{\partial t}\rho\ dV \end{aligned} \tag{17}$$

based on the classical equation [34, 35, 38] for each variable f (such as $\frac{1}{2}\mathbf{v}^2$ , u and ψ):

$$\frac{d}{dt}\iiint_\tau f\rho\ dV = \iiint_\tau \left(\frac{df}{dt}\right)\rho\ dV, \tag{18}$$

where the operator d/dt denotes the total derivative [4, 34, 35, 36, 38, 39] following the continuum substance. The generalized differential formulation (17) extends the formulation ((4.28) in monograph [39]) of the first law of thermodynamics by taking into account (along with the classical [9, 33, 39] internal thermal energy $U_\tau \equiv U$ and the macroscopic kinetic energy $K_\tau$ [4-6, 39]) the established [4-6] gravitational potential energy $\Pi_\tau$ (given by (14)) and the established [5, 6] differential energy gravitational influence dG (given by (13)) on the individual finite continuum region **τ** (during the infinitesimal time interval dt ) as the result of the Newtonian non-stationary gravitation.

The generalized differential formulations (10) and (17) of the first law of thermodynamics can be rewritten as follows [5, 6, 18, 19]:

$$dU_\tau + dK_\tau + d\Pi_\tau = \delta Q + \delta A_{np,\partial\tau} + dG \tag{19}$$

extending the classical [9, 33] formulations (1) and (2):

$$dU = \delta Q - pdV,\ \left(d\varepsilon \equiv dU,\ -\delta W = -pdV\right) \tag{20}$$

by taking into account (along with the classical [9, 33] infinitesimal change of heat $\delta Q$ and the classical [9, 33] infinitesimal change of the internal energy $dU_\tau \equiv dU$) the infinitesimal increment $dK_\tau$ of the macroscopic kinetic energy $K_\tau$, the infinitesimal increment $d\Pi_\tau$ of the gravitational potential energy $\Pi_\tau$, the generalized [5, 6] infinitesimal work $\delta A_{np,\partial\tau}$ done on the individual finite continuum region τ by the surroundings of τ, and the differential (infinitesimal) energy gravitational influence dG [5, 6, 18, 19] on the individual finite continuum region $\tau$ during the infinitesimal time interval dt.

The equivalent generalized differential formulations (10), (17) and (19) of the first law of thermodynamics take into account the following factors:

1) the classical [9, 33-35] heat thermal molecular conductivity (across the boundary ∂τ of the individual finite continuum region τ) related with the classical [9, 33-35] infinitesimal change of heat $\delta Q$ (given by (12)),

2) the classical [9, 33-35] infinitesimal change $dU_\tau$ of the internal thermal energy $U_\tau$ of the individual finite continuum region τ:

$$dU_\tau = d\iiint_\tau u\rho dV, \tag{21}$$

3) the established [4-8, 18-21, 23-27] infinitesimal increment $dK_\tau$ of the macroscopic kinetic energy $K_\tau$ of the individual finite continuum region τ:

$$dK_\tau = d\iiint_\tau \rho \frac{\mathbf{v}^2}{2} dV, \tag{22}$$

 

4) the established [4-8, 18-21, 23-27] infinitesimal increment $d\Pi_\tau$ of the gravitational potential energy $\Pi_\tau$ of the individual finite continuum region $\tau$:

$$d\Pi_\tau = d\iiint_\tau \psi\ \rho\ dV, \tag{23}$$

5) the established [4-8, 18-21, 23-27] generalized infinitesimal work $\delta A_{np,\partial\tau}$ done on the individual finite continuum region $\tau$ by the surroundings of $\tau$:

$$\delta A_{np,\partial\tau} = dt\iint_{\partial\tau}\left(\mathbf{v}\cdot\left(\mathbf{n}\cdot\mathbf{T}\right)\right) d\Omega_{\mathbf{n}}, \tag{24}$$

6) the established [4-8, 18-21, 23-27] differential (during the infinitesimal time interval dt) energy gravitational influence dG (given by (13)) on the individual finite continuum region $\tau$.

The equivalent generalized differential formulations (10), (17) and (19) of the first law of thermodynamics (given for the Galilean frame of reference) are valid for non-equilibrium shear-rotational states of the deformed individual finite continuum region $\tau$ (characterized by the symmetric [34, 35, 38] stress tensor $\mathbf{T}$ represented in the general equation (9) of continuum movement [35, 38]) moving in the Newtonian non-stationary gravitational field. The generalized differential formulations (10), (17) and (19) of the first law of thermodynamics [5, 6] are the fundamental generalizations (of the classical [9, 33] formulations (1) and (2) of the first law of thermodynamics) taking into account: 1) the established [4, 5, 6] infinitesimal increment $dK_\tau$ (given by (22)) of the macroscopic kinetic energy $K_\tau$ of the individual finite continuum region $\tau$, 2) the established [4, 5, 6] infinitesimal increment $d\Pi_\tau$ (given by (23)) of the gravitational potential energy $\Pi_\tau$ of the individual finite continuum region $\tau$, 3) the established [4, 5, 6] generalized infinitesimal work $\delta A_{np,\partial\tau}$ (given by (24)) done (during the infinitesimal time interval dt) by non-potential stress forces acting on the boundary surface $\partial\tau$ of the individual finite continuum region $\tau$, and 4) the established [5, 6] differential (infinitesimal) energy gravitational influence (during the infinitesimal time interval dt as the result of the Newtonian non-stationary gravitation) dG (given by (13)) on the individual finite continuum region $\tau$ as a result of the time variations of the potential $\psi$ of the Newtonian non-stationary gravitational field inside the individual finite continuum region $\tau$.

Considering the restrictive conditions $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG=0$ for the generalized differential formulation (19) of the first law of thermodynamics, we obtained [20] the conservation of the total energy $U_\tau+K_\tau+\Pi_\tau=const$ [20, 39] of the individual finite continuum region $\tau$. Considering the adiabatic stationary fluid motion of an ideal fluid characterized by the restrictive conditions $dU_\tau=0$, $\delta Q=0$ and $dG=0$, we pointed out [24] that the generalized differential formulation (19) of the first law of thermodynamics is reduced to the classical Bernoulli integral for the adiabatic stationary fluid motion of an ideal fluid along a considered streamline. We pointed out [24] that under the restrictive conditions $dU_\tau=0$, $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG=0$, $dK_\tau\neq0$ and $d\Pi_\tau\neq0$, the generalized differential formulation (19) of the first law of thermodynamics (used for the planet $\tau$ subjected to the central stationary Newtonian gravitational field) results to the classical Kepler's laws describing the elliptical orbital planetary motion. We pointed out [24] that under the restrictive conditions $dU_\tau=0$, $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG\neq0$, $dK_\tau\neq0$ and $d\Pi_\tau\neq0$ the generalized differential formultion (19) of the first law of thermodynamics (used for the planet $\tau$ and the Sun $\tau_0$ (the central star) interacting owing to the classical Newtonian non-stationary gravitational field) results to the classical Kepler's laws describing the elliptical orbital planetary and solar motions.

## 3 The Fundamentals of the Thermohydrogravidynamic Theory Related with the Increased Intensifications of the Global Activity of the Earth

### 3.1 The Energy Gravitational Influence of the Sun on the Earth Owing to the Gravitational Interaction of the Sun with the Outer Large Planets of the Solar System

#### 3.1.1 The evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth

We shall consider the movement of the Sun, the Earth $\tau_3$ and the outer large planet $\tau_j$ ( $j = 5, 6, 7, 8$) in the ecliptic plane (see Fig. 2) around the combined mass center C(S,j) of the Sun and the outer large planet $\tau_j$ in the approximation of the elliptical orbits of the Sun, the Earth and the outer large planet $\tau_j$. The combined mass center C(S,j) of the system the Sun – the outer large planet $\tau_j$ (the Sun and the outer large planet $\tau_j$) is considered [19] as the right focus $F_1 \equiv C(S,j)$ of the elliptical orbits of the outer large planet $\tau_j$ $(j = 5, 6, 7, 8)$ and the Earth $\tau_3$.

We have the following relations [19]:

$$r_j(\phi_j(t)) = \frac{p_j}{(1 + e_j\cos\phi_j(t))}, \quad (j = 5, 6, 7, 8) \tag{25}$$

$$r_{Sj}(\phi_{Sj}(t)) = r_{Sj}(\phi_j(t) + \pi\ ) = \frac{p_{Sj}}{(1 + e_{Sj}\cos\phi_j(t))}, \left(j = 5, 6, 7, 8\right) \tag{26}$$

$$r_3(\phi_3(t)) = \frac{p_3}{(1 + e_3\cos\phi_3(t))} \tag{27}$$

for the distance $r_j(\phi_j)$ between combined mass center C(S,j) and the mass center $C_j$ of the planet $\tau_j$, for the distance $r_{Sj}(\phi_j+\pi\ )$ between combined mass center C(S,j) and the mass center $C_S \equiv O$ of the Sun, and for the distance $r_3(\phi_3(t))$ between combined mass center C(S,j) and the mass center $C_3$ of the Earth $\tau_3$, respectively. Here $p_j$ and $e_j$ are the focal parameter and the eccentricity, respectively, of the elliptical orbit of the planet $\tau_j$ $(j = 5, 6, 7, 8)$. $p_{Sj}$ and $e_{Sj}=e_j$ are the focal parameter and the eccentricity, respectively, of the elliptical orbit of the mass center $C_S \equiv O$ of the Sun. $p_3$ and $e_3$ are the focal parameter and the eccentricity, respectively, of the elliptical Earth's orbit.

We considered [19] $\phi_j(0)=0$ $(j = 5, 6, 7, 8)$, $\phi_{Sj}(0)=\pi$ and $\phi_3(0)=0$, respectively, for the initial time moment t=0. We considered [19] the gravitational potential $\psi_{3j}^S(C_3,\ t) \equiv \psi_{3j}^S(C_3,\ t,\ r_3(\phi_3(t)))$ created by the Sun in the mass center $C_3$ (of the Earth $\tau_3$) characterized by the distance $r_3(\phi_3(t))$ between the combined mass center C(S,j) of the Sun and the planet $\tau_j$:

$$\psi_{3j}^S(C_3,\ t,\ r_3(\phi_3(t))\ ) = -\gamma\frac{M_S}{r_{S3}(t)}, \tag{28}$$

where $M_S=333000 \cdot M_3$ is the mass of the Sun, $r_{S3}(t) = |\mathbf{r}_{S3}(t)|$ is the distance between the mass center $C_S \equiv O$ of the Sun and the mass center $C_3$ of the Earth $\tau_3$.

We have the distance $r_{S3}(t)$ from the following relation [19]:

$$(r_{S3}(t))^2 = (r_{Sj}(t))^2 + (r_3(t))^2 - 2r_{Sj}(t)r_3(t)\cos(\pi + \phi_j(t) - \phi_3(t)). \tag{29}$$

Consequently, the relation (28) can rewritten as follows [19]:

$$\psi_{3j}^S(C_3,\ t\ ) = -\frac{\gamma M_S}{\sqrt{(r_{Sj}(t))^2 + (r_3(t))^2 - 2r_{Sj}(t)r_3(t)\cos(\pi + \phi_j(t) - \phi_3(t))}}. \tag{30}$$

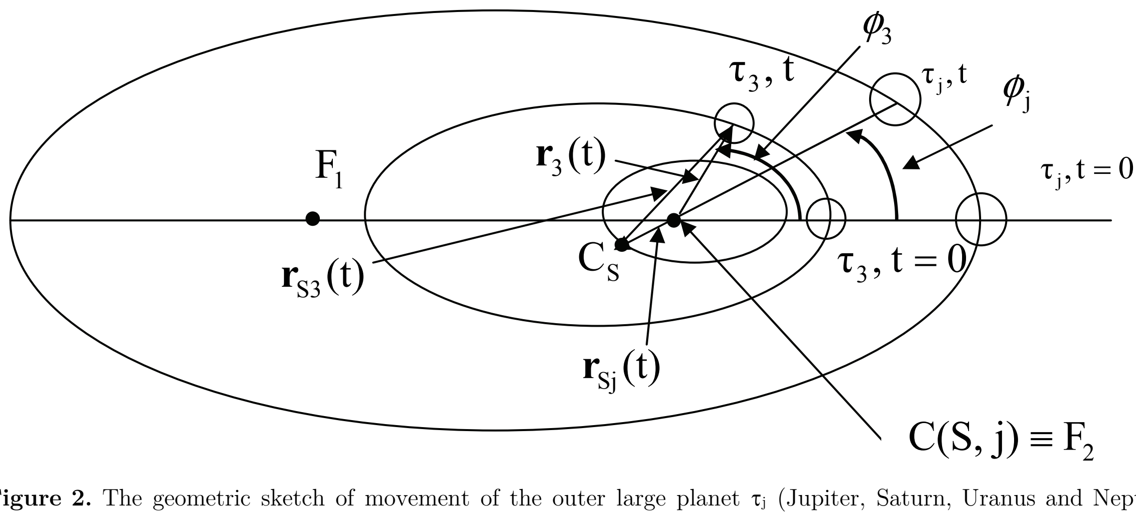


**Figure 2.** The geometric sketch of movement of the outer large planet $\tau_j$ (Jupiter, Saturn, Uranus and Neptune) and the Earth $\tau_3$ around the combined mass center C(S,j) of the Sun $\tau_0$ and the outer large planet $\tau_j$.

 

We obtained [19] the expression for the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$ of the gravitational potential $\psi_{3j}^{S}(C_3, t)$:

$$\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3,t) = \frac{\gamma M_S r_{Sj}(\phi_j + \pi) r_3(\phi_3)\sin(\phi_3 - \phi_j)}{(r_{S3}(t))^3}\frac{d\phi_j(t)}{dt} + \frac{\gamma M_S r_{Sj}(\phi_j + \pi) e_{Sj}\sin\phi_j [r_{Sj}(\phi_j + \pi) + r_3(\phi_3)\cos(\phi_3 - \phi_j)]}{(r_{S3}(t))^3(1 + e_{Sj}\cos\phi_j)}\frac{d\phi_j(t)}{dt}. \tag{31}$$

Using the expressions (26), (27) and (29), the relation (31) can be rewritten as follows [19]:

$$\begin{aligned}\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3,t) = {} & \gamma M_S \frac{p_{Sj}}{(1+e_{Sj}\cos\phi_j)}\frac{p_3}{(1+e_3\cos\phi_3)}\sin(\phi_3-\phi_j) \\ & \times\frac{\frac{d\phi_j(t)}{dt}}{\left[\left(\frac{p_{Sj}}{(1+e_{Sj}\cos\phi_j)}\right)^2+\left(\frac{p_3}{(1+e_3\cos\phi_3)}\right)^2+2\frac{p_{Sj}p_3\cos(\phi_j-\phi_3)}{(1+e_{Sj}\cos\phi_j)(1+e_3\cos\phi_3)}\right]^{\frac{3}{2}}} \\ & +\frac{\gamma M_S p_{Sj} e_{Sj}\sin\phi_j}{(1+e_{Sj}\cos\phi_j)^2}\left[\frac{p_{Sj}}{(1+e_{Sj}\cos\phi_j)}+\frac{p_3\cos(\phi_3-\phi_j)}{(1+e_3\cos\phi_3)}\right] \\ & \times\frac{\frac{d\phi_j(t)}{dt}}{\left[\left(\frac{p_{Sj}}{(1+e_{Sj}\cos\phi_j)}\right)^2+\left(\frac{p_3}{(1+e_3\cos\phi_3)}\right)^2+2\frac{p_{Sj}p_3\cos(\phi_j-\phi_3)}{(1+e_{Sj}\cos\phi_j)(1+e_3\cos\phi_3)}\right]^{\frac{3}{2}}}.\end{aligned} \tag{32}$$

The first term of the expression (32) gives the principal contribution to the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$. The expression (32) contains the additional second term (vanishing at $e_{Sj}\to 0$) related with the contribution to the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$ of the eccentricities $e_j$ and $e_{Sj}= e_j$ of the elliptical orbits of the outer large planet $\tau_j$ (j=5, 6, 7, 8) and the Sun, respectively.

The combined maximal contribution of this additional second term to the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$ is of the order

$$O(e_j)\left(\max\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)\right). \tag{33}$$

Consequently, the contribution of the first term of the expression (32) is $O(1/e_j)$ times larger than the contribution of the additional second term related with the eccentricities $e_j$ and $e_{Sj}=e_j$ of the elliptical orbits of the outer large planet $\tau_j$ (j=5, 6, 7, 8) and the Sun, respectively.

To evaluate the characteristic maximal positive value $\text{char. max. pos.}\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$ of the partial derivative $\frac{\partial}{\partial t}\psi_{3j}^{S}(C_3, t)$ (given by the expression (32)) we considered [19] the time moments $t_*(k)$ related with the conditions

$$\sin(\phi_3 - \phi_j) = 1,\ \cos(\phi_3 - \phi_j) = 0, \tag{34}$$

which give the following relation for the angles $\phi_3$ and $\phi_j$

$$(\phi_3 - \phi_j) = \frac{\pi}{2} + 2\pi\ k,\ k = 0,1,2.... \tag{35}$$

Considering the following relations (for the corresponding hypothetical circular orbits of the Earth and the planet $\tau_j$ (j=5, 6, 7, 8)) for the angles $\phi_3(t)$ and $\phi_j(t_*)$:

$$\phi_3(t) \approx \frac{2\pi}{T_3} t, \;\; \phi_j(t_*) \approx \frac{2\pi}{T_j} t, \tag{36}$$

the condition (35) gives (for $k = 0$) the following time $t_*$ and the corresponding angles $\phi_3(t_*)$ and $\phi_j(t_*)$:

$$t_* = \frac{1}{4}\frac{T_3 T_j}{(T_j - T_3)}, \phi_3(t_*) = \frac{\pi}{2}\frac{T_j}{(T_j - T_3)}, \phi_j(t_*) = \frac{\pi}{2}\frac{T_3}{(T_j - T_3)}, \tag{37}$$

which give the characteristic maximal positive value $\text{char. max. pos.}\ \frac{\partial}{\partial t}\psi^S_{3j}(C_3,\, t)$ of the partial derivative $\frac{\partial}{\partial t}\psi^S_{3j}(C_3,\, t)$ [19]:

$$\begin{aligned}
&\text{char. max. pos.}\ \frac{\partial}{\partial t}\psi^S_{3j}(C_3,\, t) \equiv \frac{\partial}{\partial t}\psi^s_{3j}(t_*) = \frac{\gamma M_S p_{Sj}}{(1 + e_{Sj}\cos\phi_j(t_*))}\frac{p_3}{(1 + e_3\cos\phi_3(t_*))}\omega_j \times \\
&\times \frac{1}{\left[\left(\frac{p_{Sj}}{(1 + e_{Sj}\cos\phi_j(t_*))}\right)^2 + \left(\frac{p_3}{(1 + e_3\cos\phi_3(t_*))}\right)^2\right]^{3/2}} + \\
&+\gamma M_S p_{Sj} e_{Sj}\sin\phi_j(t_*)\frac{p_{Sj}}{(1 + e_{Sj}\cos\phi_j(t_*))^3}\omega_j \frac{1}{\left[\left(\frac{p_{Sj}}{(1 + e_{Sj}\cos\phi_j(t_*))}\right)^2 + \left(\frac{p_3}{(1 + e_3\cos\phi_3(t_*))}\right)^2\right]^{3/2}}.
\end{aligned} \tag{38}$$

We used [19] the relation [6-8] for the maximal positive value $\max_t \frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ (of the partial derivative $\frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ of the gravitational potential $\psi_{3M}(C_3,\text{int})$ created by the Mercury (moving around the mass center O of the Sun along the hypothetical circular orbit) at the mass center $C_3$ of the Earth):

$$\max_t \frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int}) = p(1,C_3)\,\frac{\gamma M_M R_{O3} R_{OM}\omega_M}{[R^2_{O3} + R^2_{OM}]^{3/2}} \tag{39}$$

as a scale for the energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8) of the Solar System) on the Earth. To evaluate the relative power of the energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8) of the Solar System) on the Earth as compared with the maximal energy gravitational influence of the Mercury, we considered [19] the ratio $f_{SUN\,M}(j,\, C_3,\, \text{char.})$ of the characteristic maximal positive value $\text{char. max. pos.}\ \frac{\partial}{\partial t}\psi^S_{3j}(C_3,\, t)$ (given by the expression (38)) and the maximal positive value $\max_t \frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})$ (given by the expression (39)):

$$\begin{aligned}
f_{SUN\,M}(j,\, C_3,\, \text{char.}) &= \frac{\text{char. max. pos.}\ \frac{\partial}{\partial t}\psi^S_{3j}(C_3,\, t)}{\max_t \frac{\partial}{\partial t}\psi_{3M}(C_3,\text{int})} \\
&= \frac{1}{2p(1,C_3)}\frac{M_j}{M_1}\frac{\left[R^2_{O3} + R^2_{O1}\right]^{3/2}}{R^3_{O3}R_{O1}}\frac{R_{Oj}T_1}{T_j}\frac{(1 - e_j^2)}{(1 - e_3^2)^2}\frac{(1 + \sqrt{1 - e_3^2})^2}{(1 + \sqrt{1 - e_j^2})} \times
\end{aligned}$$

 

$$\times \frac{1}{(1+e_{Sj}\cos\phi_j(t_*))\left\{\left(\frac{p_{Sj}}{p_3}\right)^2 \frac{1}{(1+e_{Sj}\cos\phi_j(t_*))^2} + \frac{1}{(1+e_3\cos\phi_3(t_*))^2}\right\}^{3/2}}$$

$$\times\left[\frac{1}{(1+e_3\cos\phi_3(t_*))} + \frac{e_{Sj}\sin\phi_j(t_*)}{(1+e_{Sj}\cos\phi_j(t_*))^2}\frac{p_{Sj}}{p_3}\right], \quad (j = 5, 6, 7, 8) \tag{40}$$

where $\left(\frac{p_{sj}}{p_3}\right)^2$ is given by the following relation (j=5, 6, 7, 8):

$$\frac{p_{Sj}^2}{p_3^2} = \left(\frac{p_j M_j}{M_S p_3}\right)^2 = \left(\frac{M_j}{M_S}\right)^2\left(\frac{p_j}{p_3}\right)^2 = \left(\frac{M_j}{M_S}\right)^2\left(\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right)^2. \tag{41}$$

Using the relation (41), the ratio $f_{SUN\ M}(j, C_3, char.)$ (given by the expression (40)) can be rewritten as follows [19]:

$$f_{SUN\ M}(j, C_3, char.) = \frac{M_j\left[R_{O3}^2 + R_{O1}^2\right]^{3/2} R_{Oj}T_1(1-e_j^2)(1+\sqrt{1-e_3^2})^2}{2p(1,C_3)M_1R_{O3}^3R_{O1}T_j(1-e_3^2)^2(1+\sqrt{1-e_j^2})}$$

$$\times\frac{1}{(1+e_{Sj}\cos\phi_j(t_*))}\frac{1}{\left\{\left(\frac{M_j}{M_S}\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right)^2\frac{1}{(1+e_{Sj}\cos\phi_j(t_*))^2} + \frac{1}{(1+e_3\cos\phi_3(t_*))^2}\right\}^{3/2}}$$

$$\times\left[\frac{1}{(1+e_3\cos\phi_3(t_*))} + \frac{e_{Sj}\sin\phi_j(t_*)}{(1+e_{Sj}\cos\phi_j(t_*))^2}\frac{M_j}{M_S}\frac{(1-e_j^2)}{(1-e_3^2)}\frac{R_{Oj}}{R_{O3}}\frac{(1+\sqrt{1-e_3^2})}{(1+\sqrt{1-e_j^2})}\right]. \quad (j = 5, 6, 7, 8) \tag{42}$$

The obtained [19] formula (42) is valid only for the outer large planets (Jupiter, Saturn, Uranus and Neptune) of the Solar System. Using the formula (42) and the planetary numerical values [6-8, 18, 40], we calculated [19] the following numerical values (of the non-dimensional energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets):

$$f_{SUN\ M}(5, C_3, char.) = 884.935424 \tag{43}$$

for the Sun owing to the gravitational interaction of the Sun with Jupiter,

$$f_{SUN\ M}(6, C_3, char.) = 194.923355 \tag{44}$$

for the Sun owing to the gravitational interaction of the Sun with Saturn,

$$f_{SUN\ M}(7, C_3, char.) = 21.27951 \tag{45}$$

for the Sun owing to the gravitational interaction of the Sun with Uranus and

$$f_{SUN\ M}(8, C_3, char.) = 20.833557 \tag{46}$$

for the Sun owing to the gravitational interaction of the Sun with Neptune.

We used [19] for calculations the following planetary numerical values [6-8, 18, 40]: the mass $M_J = M_5 = 318M_3$ of Jupiter (where $M_3$ is the mass of the Earth), the time period $T_J = T_5 = 4332$ days of Jupiter's circulation around the Sun and the average radius $R_{OJ} = R_{O5} = 777.6\cdot10^6$ km of Jupiter's orbit, the mass $M_{SAT} = M_6 = 95.2M_3$ of Saturn, the time period $T_{SAT} = T_6 = 10759$ days of Saturn's circulation around the Sun and the average radius $R_{OSAT} = R_{O6} = 1426\cdot10^6$ km of Saturn's orbit, the mass $M_U = M_7 = 14.6M_3$ of Uranus, the time period $T_U = T_7 = 30685$ days of Uranus' circulation around the Sun and the average radius $R_{OU} = R_{O7} = 2868\cdot10^6$ km of Uranus' orbit, the mass $M_N = M_8 = 17.2M_3$ of Neptune, the time period $T_N = T_8 = 60189$ days of Neptune's circulation around the Sun and the average radius $R_{ON} = R_{O8} = 4497\cdot10^6$ km of Neptune's orbit.

Taking into account the calculated numerical values $f_{SUN\ M}(j, C_3, char.)$ (j=5, 6, 7, 8), we obtained

 

[19] the following order of significance of the outer large planets of the Solar System: Jupiter ($\tau_5$), Saturn ($\tau_6$), Uranus ($\tau_7$) and Neptune ($\tau_8$) in respect of the evaluated characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System.

### 3.1.2 The evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets

We used [19] the relation (31) for evaluation of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the outer large planets of the Solar System. Considering the orbit of the outer large planet $\tau_j$ (j=5, 6, 7, 8) of the Solar System as the circular (in the first approximation), we obtained [19] that the orbit of the mass center $C_S \equiv O$ of the Sun may be considered as circular also (in the first approximation) for the closed system the Sun − the outer large planet $\tau_j$ (the Sun and the outer large planet $\tau_j$). As a result, we considered (in the first approximation [19]) in the relation (31) the average radius $\langle r_{Sj} \rangle$ instead of $r_{Sj}$ for the hypothetical circular orbit of the mass center $C_S \equiv O$ of the Sun in the closed system the Sun − the outer large planet $\tau_j$ (j=5, 6, 7, 8). We considered (in the first approximation [19]) in the relation (31) the average radius $R_{O3}$ of the Earth's orbit instead of $r_3$. The average radius $\langle r_{Sj} \rangle$ is given by the following expression [19]

$$\langle r_{Sj} \rangle = R_{Oj} \frac{M_j}{M_S}, \tag{47}$$

where $M_S$ is the mass of the Sun, $M_j$ is the mass of the planet $\tau_j$ (j=5, 6, 7, 8). Using the relation (47) and the relations $\phi_3=\omega_3 t$, $\phi_j=\omega_j t$ (for the hypothetical circular orbits of the Earth and the planet $\tau_j$ around the combined mass center C(S,j) of the Sun and the planet $\tau_j$), the relation (31) can be rewritten as follows [19]

$$\frac{\partial}{\partial t}\psi^S_{3j}(C_3,t) = \frac{\gamma M_j R_{Oj} R_{O3}\omega_j \sin(\omega_3-\omega_j)t}{\left[\left(R_{Oj}\frac{M_j}{M_S}\right)^2 + R^2_{O3} + 2R_{Oj}\frac{M_j}{M_S}R_{O3}\cos(\omega_j-\omega_3)t\right]^{3/2}}. \tag{48}$$

The main interest of this Section 3.1.2 is related with the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8):

$$\max_t \Delta_g E_3(\text{Sun}-\tau_j,\phi_{0j},\phi_{03},t,t_0) \tag{49}$$

under the following initial (for the initial time moment $t=t_0$) angles: $\phi_{0j}=0$ and $\phi_{03}=0$ characterizing the initial configuration (see Fig. 2) of the outer large planet $\tau_j$ and the Earth $\tau_3$, respectively. These initial angles ($\phi_{0j}=0$ and $\phi_{03}=0$) correspond (see Fig. 2) to the minimal distance between the mass center $C_j$ of the outer large planet $\tau_j$ and the mass center $C_3$ the Earth $\tau_3$ for the initial time moment $t=t_0=0$. Taking into account $\phi_{0j}=0$, $\phi_{03}=0$ and using the derived expression (48) for $\frac{\partial}{\partial t}\psi^S_{3j}(C_3,t)$, we obtained [19] the following expression for the integral energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planet $\tau_j$:

$$\begin{aligned}\Delta_g E_3(\text{Sun}-\tau_j,0,0,t,t_0) &= M_3\int_{t_0}^{t}\frac{\partial}{\partial t'}\psi^S_{3j}\left(C_3,t'\right)dt' \\ &= M_3\int_{t_0}^{t}\frac{\gamma M_j R_{Oj}R_{O3}\omega_j\sin(\omega_3-\omega_j)t'dt'}{\left[\left(R_{Oj}\frac{M_j}{M_S}\right)^2 + R^2_{O3} + 2R_{Oj}\frac{M_j}{M_S}R_{O3}\cos(\omega_j-\omega_3)t'\right]^{3/2}}.\end{aligned} \tag{50}$$

Introducing the following designations

 

$$\beta_{Sj}=R_{O3}^2+\left(R_{Oj}\frac{M_j}{M_S}\right)^2,\quad \chi_{Sj}=2R_{O3}R_{Oj}\frac{M_j}{M_S},\quad \alpha_j=\gamma M_3M_jR_{O3}R_{Oj}\omega_j, \tag{51}$$

the expression (50) can be rewritten as follows [19]

$$\Delta_g E_3=(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\int_{t_0}^{t}\frac{\alpha_j\sin(\omega_3-\omega_j)t'dt'}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t'\right]^{3/2}}. \tag{52}$$

Introducing the new variable $u=\cos(\omega_j-\omega_3)t'$, the expression (52) can be rewritten as follows [19]

$$\Delta_g E_3=(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\int_{\cos(\omega_j-\omega_3)t_0}^{\cos(\omega_j-\omega_3)t}\frac{\alpha_j du}{(\omega_j-\omega_3)\left[\beta_{Sj}+\chi_{Sj}u\right]^{3/2}}. \tag{53}$$

Taking into account the relation (C is an arbitrary constant)

$$\int\frac{du}{\left[\beta_{Sj}+\chi_{Sj}u\right]^{3/2}}=F(u)=-\frac{2}{\chi_{Sj}}\frac{1}{\left[\beta_{Sj}+\chi_{Sj}u\right]^{1/2}}+C, \tag{54}$$

and integrating the relation (53), we obtained [19] the following expression

$$\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,t_0)=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t\right]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t_0\right]^{1/2}}\right\}. \tag{55}$$

Considering the initial time moment $t_0=0$, the expression (55) gives the relation [19]:

$$\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\cos(\omega_j-\omega_3)t\right]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}. \tag{56}$$

Based on the relation (56), we obtained [19] the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8):

$$\max_t \Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t_1^*(3,j),0)=$$
$$=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{[\beta_{Sj}-\chi_{Sj}]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}, \tag{57}$$

which are attained at first under the time moments $t=t_1^*(3,j)=\frac{1}{2}\frac{T_3T_j}{(T_j-T_3)}$, where j=5, 6, 7, 8.

The following time moments

$$t_n^c(3,j)=\frac{1}{2}\frac{T_3T_j}{(T_j-T_3)}+n\frac{T_3T_j}{(T_j-T_3)},\ (j = 5, 6, 7, 8;\ n = 0, 2, 3, \ldots\ldots) \tag{58}$$

give the same maxima [19]

$$\max_t \Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t,0)=\Delta_g E_3(\mathrm{Sun}-\tau_j,0,0,t_n^c(3,j),0)=$$
$$=\frac{2\alpha_j}{(\omega_3-\omega_j)\chi_{Sj}}\left\{\frac{1}{[\beta_{Sj}-\chi_{Sj}]^{1/2}}-\frac{1}{\left[\beta_{Sj}+\chi_{Sj}\right]^{1/2}}\right\}, \tag{59}$$

which are attained under the time moments $t=t_n^c(3,j)$, where j = 5, 6, 7, 8; n = 0, 1, 2, 3, … . The time moments $t=t_n^c(3,j)$ define the planetary configurations characterizing by the maximal distances between the mass center $C_j$ of the outer large planet $\tau_j$ (j = 5, 6, 7, 8) and the mass center $C_3$ of the Earth $\tau_3$. Taking into account the designations (51), the relation (59) can be rewritten as follows [19]

 

$$\max_t \Delta_g E_3(\text{Sun} - \tau_j,\ 0,\ 0,t,\ 0) = \frac{2\gamma M_3 M_j R_{Oj} T_3}{(T_j - T_3)} \frac{1}{\left(R_{O3}^2 - \left(\frac{R_{Oj} M_j}{M_S}\right)^2\right)}. \tag{60}$$

We consider the expression (see [18] and the formula (134) [18] used for i =1)

$$\max_t \Delta_g E_3(\tau_1,0,0,t,0) = \Delta_g E_3(\tau_1,0,0,t_1^*(1,3),0)$$
$$= 2\gamma M_3 M_1 \frac{R_{O1} T_3}{(R_{O3}^2 - R_{O1}^2)(T_3 - T_1)} > 0, \quad (\text{i}= 1) \tag{61}$$

as a measuring unit for evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8). Considering the ratio of the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\text{Sun} - \tau_j, 0, 0, t, 0)$ (given by the expression (60)) of the Sun on the Earth (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$) and the maximal positive integral energy gravitational influence $\max_t \Delta_g E_3(\tau_1,0,0,t,0)$ (given by the expression (61)) of Mercury on the Earth, we obtained [19] the relative values s(Sun$-\tau_j$, first approx.) of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8):

$$\text{s}(\text{Sun} - \tau_j,\ \text{first approx.}) = \frac{\max_t \Delta_g E_3(\text{Sun-}\tau_j,\ 0,\ 0,t,\ 0)}{\max_t \Delta_g E_3(\tau_1,\ 0,\ 0,t,\ 0)} =$$
$$= \frac{M_j}{M_1} \frac{R_{Oj}}{R_{O1}} \frac{(T_3\text{-}T_1)}{(T_j\text{-}T_3)} \frac{(R_{O3}^2\text{-}R_{O1}^2)}{\left(R_{O3}^2 - \left(\frac{R_{Oj} M_j}{M_S}\right)^2\right)}. \tag{62}$$

Using the formula (62) and the planetary numerical values [6-8, 18, 40] of the average radii of orbits of the Earth, Mercury and Jupiter (j = 5), the time periods of circulations around the Sun and the masses of Jupiter, Mercury and the Sun, we calculated [19] the numerical value

$$\text{s}(\text{Sun} - \tau_5,\ \ \text{first approx.}) = 4235.613239, \tag{63}$$

which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with Jupiter) on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$) is $\text{s}(\text{Sun} - \tau_5, \text{first approx.})/\text{s}(5) = 4235.613239 / 31.319 = 135.2410115$ times larger than the maximal integral energy gravitational influence of Jupiter on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$).

Using the formula (62) and the planetary numerical values [6-8, 18, 40] of the average radii of orbits of the Earth, Mercury and Saturn (j = 6), the time periods of circulations around the Sun and the masses of Saturn, Mercury and the Sun, we calculated [19] the numerical value

$$\text{s}(\text{Sun} - \tau_6,\ \text{first approx.}) = 887.4442965, \tag{64}$$

which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with Saturn) on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$) is $\text{s}(\text{Sun} - \tau_6, \text{first approx.})/\text{s}(6) = 887.4442965/1.036 = 856.6064638$ times larger than the maximal integral energy gravitational influence of Saturn on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$).

Using the formula (62) and the planetary numerical values [6-8, 18, 40] of the average radii of orbits of the Earth, Mercury and Uranus (j = 7), the time periods of circulations around the Sun and the masses of Uranus, Mercury and the Sun, we calculated [19] the numerical value

$$\text{s}(\text{Sun} - \tau_7,\ \text{first approx.}) = 93.8337322, \tag{65}$$

which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with Uranus) on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$) is $s(\text{Sun}-\tau_7, \text{first approx.})/s(7) = 93.8337322/0.0133 = 7055.167834$ times larger than the maximal integral energy gravitational influence of Uranus on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$).

Using the formula (62) and the planetary numerical values [6-8, 18, 40] of the average radii of orbits of the Earth, Mercury and Neptune (j = 8), the time periods of circulations around the Sun and the masses of Neptune, Mercury and the Sun, we calculated [19] the numerical value

$$s(\text{Sun}-\tau_8, \text{first approx.}) = 87.8477601, \qquad (66)$$

which means that the maximal integral energy gravitational influence of the Sun (owing to the gravitational interaction of the Sun with Neptune) on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$) is $s(\text{Sun}-\tau_8, \text{first approx.})/s(8) = 87.8477601/0.003229 = 27205.87182$ times larger than the maximal integral energy gravitational influence of Neptune on the unit mass of the Earth (at the mass center $C_3$ of the Earth $\tau_3$).

Taking into account the calculated [19] relative values $s(\text{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8), we obtained [19] the following order of signification of the outer large planets $\tau_j$ (j=5, 6, 7, 8) of the Solar System: Jupiter ($s(\text{Sun}-\tau_5, \text{first approx.}) = 4235.613239$), Saturn ($s(\text{Sun}-\tau_6, \text{first approx.}) = 887.4442965$), Uranus ($s(\text{Sun}-\tau_7, \text{first approx.}) = 93.8337322$), and Neptune ($s(\text{Sun}-\tau_8, \text{first approx.}) = 87.8477601$), in respect of the established [19] evaluation of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8). We established [19] that the Sun induce the main maximal integral energy gravitational influences on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8).

Considering the aspect of the cosmic gravitational preparation of the strong earthquakes, we stated [19] the established predominance of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with Jupiter ($s(\text{Sun}-\tau_5, \text{first approx.}) = 4235.613239$), Saturn ($s(\text{Sun}-\tau_6, \text{first approx.}) = 887.4442965$), Uranus ($s(\text{Sun}-\tau_7, \text{first approx.}) = 93.8337322$), and Neptune ($s(\text{Sun}-\tau_8, \text{first approx.}) = 87.8477601$) along with the established [6, 7, 18] Venusian (s(2)=89.6409) and Jupiter's (s(5)=31.319) planetary energy gravitational predominance and the established [7, 8, 18] significant maximal integral energy gravitational influence of the Moon (s(Moon, second approx.)=13.0693) on the Earth.

Taking into account the previously established planetary [6, 7, 18] and lunar [7, 8, 18] numerical values, and also the calculated [19] relative values $s(\text{Sun}-\tau_j, \text{first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8), we obtained [19] the following order of significance of the cosmic bodies of the Solar System: the Sun (owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune), Venus, Jupiter, the Moon, Mars, Saturn, Mercury, Uranus, Neptune and Pluto in respect of the evaluated integral energy gravitational influences of these cosmic bodies on the Earth.

### 3.1.3 The evidence of the integral energy gravitational influence on the Earth of the Sun and the Moon as the predominant cosmic trigger mechanism of earthquakes

Considering [18] the instantaneous and integral energy gravitational influences on the Earth of the planets of the Solar System and the Moon, we demonstrated [18] the cosmic (planetary and lunar) energy gravitational genesis of preparation and triggering of earthquakes. We established [18, 19] the following order of significance of the planets of the Solar System and the Moon for the cosmic gravitational preparation of the strong earthquakes: Venus (s(2)=89.6409) Jupiter (s(5)=31.319), the Moon (s(Moon, second approx.)=13.0693), Mars (s(4)=2.6396), Saturn (s(6)=1.036), Mercury (s(1)=1), Uranus (s(7)=0.0133), Neptune (s(8)=0.003229), and Pluto ($s(9)=1.4495\cdot10^{-7}$. We established [18, 19] the different order of significance of the planets of the Solar System and the Moon related to the defined relative average values e(i): the Moon s(Moon, second approx.)=13.0693), Venus (e(2)=4.5342), Jupiter (e(5)=2.3182), Mercury (e(1)=0.2547), Mars (e(4)=0.0999), Saturn (e(6)=0.0809), Uranus (e(7)=0.001066), Neptune (e(8)=0.0002594), and Pluto (e(9)=$1.1671\cdot10^{-8}$. Taking into account the obtained [6] numerical values e(i) for the planets of the Solar System and the numerical value s(Moon, second approx.)=13.0693 for the Moon [7, 8], we recognized [18] the established [7, 8] predominant significance of the Moon (along with the minor significance of Venus, Jupiter and Mercury) as the predominant lunar cosmic trigger mechanism of earthquakes prepared by the combined (planetary and lunar) integral energy gravitational influences on the Earth of Venus, Jupiter, the Moon, Mars and Mercury.

Taking into account the presented additional significant results of Sections 3.1.1 and 3.1.2, we can understand now the relative (normalized on the maximal integral energy gravitational influence of Mercury (i=1) on the Earth) average values $e_S(j)$ (corresponding to the time duration $T_{MOON}/2$ of the evaluated [7, 8, 18, 19] maximal integral energy gravitational influence of the Moon on the Earth) of the established [19] integral energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8). This evaluation [19] is based on the following formula:

$$e_S(j) = s(\mathrm{Sun} - \tau_j, \text{ first approx.}) \frac{0.5T_{MOON}}{T_g(j)}, \quad j = 5, 6, 7, 8. \tag{67}$$

We taken into account [19] the time durations of the maximal integral energy gravitational influences on the Earth of the Sun owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$, and Neptune $\tau_8$):

$$T_g(j) = t_1^*(3,j) = \frac{1}{2}\frac{T_j T_3}{(T_j - T_3)}, \quad (j = 5, 6, 7, 8) \tag{68}$$

which are the time durations of supplying of the cosmic solar gravitational energy from the Sun (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$, j=5, 6, 7, 8) to the focal region [18] of the prepared earthquakes. Taking into account the calculated [19] relative values $s(\mathrm{Sun} - \tau_j, \text{ first approx.})$ of the maximal integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$ (j=5, 6, 7, 8) and using the expressions (67) and (68), we calculated [19] the following numerical values: $e_S(5)$=313.5305 (for the Sun owing to the gravitational interaction of the Sun with Jupiter $\tau_5$), $e_S(6)$=69.3047 (for the Sun owing to the gravitational interaction of the Sun with Saturn $\tau_6$), $e_S(7)$=7.4951 (for the Sun owing to the gravitational interaction of the Sun with Uranus $\tau_7$), and $e_S(8)$=7.0584 (for the Sun owing to the gravitational interaction of the Sun with Neptune $\tau_8$).

Taking into account the obtained [6, 18] numerical values e(i) for the planets of the Solar System, the numerical value s(Moon, second approx.)=13.0693 [7, 8, 18] for the Moon and the obtained [19] numerical values $e_S(j)$ for the Sun (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$, j=5, 6, 7, 8), we established [19] the predominant significance of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$ and Saturn $\tau_6$) and the Moon as the predominant cosmic trigger mechanism (along with the minor significance of the Sun (owing to the gravitational interactions of the Sun with Uranus $\tau_7$ and Neptune $\tau_8$), Venus, Jupiter and Mercury) of the earthquakes prepared by the combined integral energy gravitational influences on the Earth of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$, and Neptune $\tau_8$), Venus, Jupiter, the Moon, Mars, and Mercury.

It was suggested [41] the hypothesis that the Chandler's wobble of the Earth's pole can be generated by the motion of the rigid kernel of the Earth induced by the disturbances in the system Sun-Earth-Moon. The considered [18] results (of Sections 4.1, 4.2 and 4.3 in article [18]) and the presented results [19] of this article (in Sections 3.1.1, 3.1.2 and 3.1.3) support the stated [7, 8] conclusion that the related geophysical phenomena (the small oscillatory motion of the rigid core (kernel) of the Earth relative to the fluid core (kernel) of the Earth [41]; the small oscillation of the Earth's pole (i.e., the Chandler's wobble of the Earth's pole); the small oscillations [42] of the boundary of the Pacific Ocean (i.e., the seismic zone of the Pacific Ring [42]); the oscillations [43], rotations, and deformations [42-44] of the geo-blocks weakly coupled with the surrounding plastic layers in all seismic zones of the Earth and the formation of fractures related with the strong earthquakes [1-3, 5-8, 10, 11, 42-47] and the planetary cataclysms [7, 8, 19]) are induced by the combined non-stationary cosmic energy gravitational influence on the Earth of the planets of the Solar System, the Sun and the Moon.

### 3.2 The Catastrophic Planetary Configurations of the Cosmic Geophysics and the Cosmic Seismology

Taking into account the considered planetary [6-8, 18] and the additional (presented in Section 3.1) very significant solar energy gravitational influences [19] on the Earth (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$, j=5, 6, 7, 8), we established [19] that the global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) are attained in two catastrophic planetary configurations (determined by the maximal and minimal planetary and solar energy gravitational influences on the Earth) shown on Fig. 3 and Fig. 4, respectively.

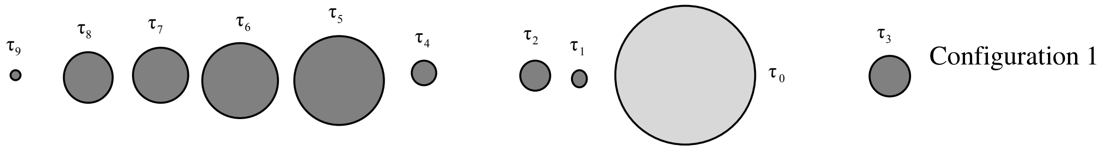


**Figure 3.** The catastrophic planetary configuration 1 determined by the maximal combined integral energy gravitational influence on the Earth ($\tau_3$) of the Sun (due to the gravitational interactions of the Sun ($\tau_0$) with Jupiter ($\tau_5$) Saturn ($\tau_6$), Uranus ($\tau_7$) and Neptune ($\tau_8$)), Mercury ($\tau_1$) Venus ($\tau_2$), Mars ($\tau_4$), and Jupiter ($\tau_5$) aligned in a straight line.

These two catastrophic planetary configurations 1 and 2 (shown on Fig. 3 and Fig. 4) are deduced from the established [19] global prediction thermohydrogravidynamic principles. The catastrophic planetary configurations 1 (shown on Fig. 3) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (17) and (19) of the first law of thermodynamics) associated with the maximal combined integral energy gravitational influence on the Earth of the planets of the Solar System and the Sun (owing to the gravitational interaction of the Sun with the outer large planets $\tau_j$, j=5, 6, 7, 8):

$$\triangle\, \mathrm{G}(\tau_3,\mathrm{t}) = \int_{\mathrm{t}_0}^{\mathrm{t}} \mathrm{dG}(\tau_3,\mathrm{t}') = \textit{local maximum for time moment } \mathrm{t}^*(\tau_3)\,, \tag{69}$$

where the time moment $t^*(\tau_3)$ is related with the maximal combined planetary and solar integral energy gravitational influence on the Earth $\tau_3$ for the time moment t= $t^*(\tau_3)$:

$$\triangle\, \mathrm{G}(\tau_3,\mathrm{t}^*(\tau_3)) = \max_{\mathrm{t}} \triangle\, \mathrm{G}(\tau_3,\mathrm{t}) = \max_{\mathrm{t}} \left\{ \sum_{i=1,i\neq 3}^{9} \int_{\mathrm{t}_0}^{\mathrm{t}} (\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial \mathrm{t}'} \rho \mathrm{dV})\mathrm{dt}' + \sum_{j=5,6,7,8} \int_{\mathrm{t}_0}^{\mathrm{t}} (\iiint_{\tau_3} \frac{\partial \psi_{3j}^{\mathrm{S}}}{\partial \mathrm{t}'} \rho \mathrm{dV})\mathrm{dt}' \right\}. \tag{70}$$

The catastrophic planetary configuration 2 (shown on Fig. 4) is founded based on the global prediction thermohydrogravidynamic principle (consistent with the generalized differential formulations (17) and (19) of the first law of thermodynamics) associated with the minimal combined planetary and solar integral energy gravitational influence on the Earth:

$$\triangle\, \mathrm{G}(\tau_3,\mathrm{t}) = \int_{\mathrm{t}_0}^{\mathrm{t}} \mathrm{dG}(\tau_3,\mathrm{t}') = \textit{local} \min \textit{imum for time moment } \mathrm{t}_*(\tau_3)\,, \tag{71}$$

where the time moment $t_*(\tau_3)$ is related with the minimal combined planetary and solar integral energy gravitational influence on the Earth $\tau_3$ for the time moment t= $t_*(\tau_3)$:

$$\triangle\, \mathrm{G}(\tau_3,\, \mathrm{t}_*(\tau_3)) = \min_{\mathrm{t}} \triangle\, \mathrm{G}(\tau_3,\mathrm{t}) = \min_{\mathrm{t}} \left\{ \sum_{i=1,i\neq 3}^{9} \int_{\mathrm{t}_0}^{\mathrm{t}} (\iiint_{\tau_3} \frac{\partial \psi_{3i}}{\partial \mathrm{t}'} \rho \mathrm{dV})\mathrm{dt}' + \sum_{j=5,6,7,8} \int_{\mathrm{t}_0}^{\mathrm{t}} (\iiint_{\tau_3} \frac{\partial \psi_{3j}^{\mathrm{S}}}{\partial \mathrm{t}'} \rho \mathrm{dV})\mathrm{dt}' \right\}. \tag{72}$$

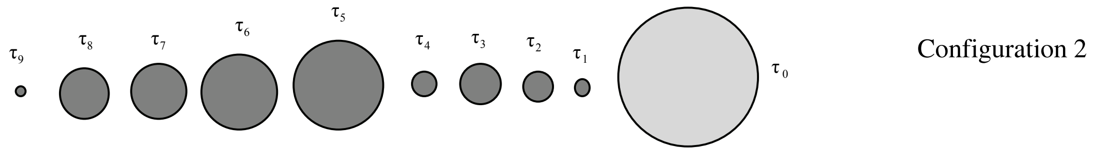


**Figure 4.** The catastrophic planetary configuration 2 determined by the minimal combined integral energy gravitational influence on the Earth ($\tau_3$) of the Sun (due to the gravitational interactions of the Sun ($\tau_0$) with Jupiter ($\tau_5$), Saturn ($\tau_6$), Uranus ($\tau_7$), and Neptune ($\tau_8$)), Mercury ($\tau_1$), Venus ($\tau_2$), Mars ($\tau_4$), and Jupiter ($\tau_5$) aligned in a straight line.

We stated [19] (according to cosmic geophysics) without any doubt that all previous global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) were occurred during a time periods of the satisfactory realization of the catastrophic planetary configurations (shown on Fig. 3 and Fig. 4, respectively) of the planets and the Sun aligned approximately in a straight line, when the planets and the Sun are visible (especially, for catastrophic planetary configuration 1 shown on Fig. 3) from the Earth within the narrow angle range (related with one or two zodiacal constellations). The catastrophic planetary configuration 1 (shown on Fig. 3) was approximately attained on 16 February, 3102 BC (the beginning of the Kali Yuga in the Hinduism), when all planets lined up approximately in a straight line (the Sun ($\tau_0$) - the Earth ($\tau_3$)) with the narrow range of angles. We concluded [20] that this approximately catastrophic planetary configuration (attained on 16 February, 3102 BC) should be related (according to the established [19, 20] global prediction thermohydrogravidynamic principle (70)) with the strong catastrophic intensification of the seismotectonic, volcanic and climatic activity of the Earth. We presented [20] the convincing evidence of the validity of this conclusion related with the fact that the date 3102 BC (16 February, 3102 BC characterized by the planetary configuration approximately resemble to the catastrophic planetary configuration 1 shown on Fig. 3) belongs to the time range (3150±90) BC [48] of the most strongest intensification (during the total range (3150±90) BC ÷ 1963 AD [48]) of the volcanic activity of the Earth. Without any doubt, we stated [19] that all future global planetary cataclysms (accompanied by the finite change of the space orientation of the Earth's axis, the irreversible deformation of the Earth's surface and by the strong catastrophic earthquakes) will be related with the time periods of the satisfactory realization of the catastrophic planetary configurations (shown on Fig. 3 and Fig. 4) of the planets and the Sun aligned approximately in a straight line.

## 3.3 The Cosmic Energy Gravitational Genesis of the Global Seismotectonic, Volcanic and Climatic Activity of the Earth Induced by the Combined Non-stationary Cosmic Gravitation

### 3.3.1 The time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth

Taking into account the results of Sections 3.1.1 and 3.1.2 (establishing the very significant energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System), we deduced [19] (using the generalized differential formulation (19) of the first law of thermodynamics) the time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune).

*3.3.1.1 The time periodicities of the maximal energy gravitational influences on the Earth of Jupiter and the Sun owing to the gravitational interaction of the Sun with Jupiter*

Based on the results [6] (see Section 4.4.1 of the article [18]), we obtained the successive approximations for the time periodicities [19]

$$(T_{J,3})_1 = 11 \ \text{years}, \tag{73}$$

 

$$(T_{J,3})_2 = 12 \ \text{years}, \tag{74}$$

$$(T_{J,3})_3 = 83 \ \text{years} \tag{75}$$

(given by (183), (184) and (185) in [18], respectively) of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth of Jupiter [6] and the Sun (owing to the gravitational interaction of the Sun with Jupiter [19]) in the first, second and third approximations, respectively.

*3.3.1.2 The time periodicities of the maximal energy gravitational influences on the Earth of Saturn and the Sun owing to the gravitational interaction of the Sun with Saturn*

If the configuration of the Earth, Saturn and the Sun is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of Saturn and the Sun (owing to the gravitational interaction of the Sun with Saturn), then the Earth, Saturn and the Sun will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth, Saturn and the Sun considered as the closed system) after $l_{SAT,3}$ circulations of Saturn and the Sun around the combined mass center of the Sun and the Saturn and $m_{3,SAT}$ circulations of the Earth around the combined mass center of the Sun and Saturn) to satisfy the following condition [19]:

$$l_{SAT,3} T_{SAT} = m_{3,SAT} T_3. \tag{76}$$

Following the known method [49], we present the ratio $T_{SAT}/T_3$ by the following mathematical fraction:

$$m_{3,SAT} / l_{SAT,3} = \frac{T_{SAT}}{T_3} = \frac{10759}{365.3} = 29 + \cfrac{1}{2 + \cfrac{1}{4 + \cfrac{347}{265}}}. \tag{77}$$

Considering the first approximation of the ratio $T_{SAT}/T_3$ given by the rational number $m_{3,SAT}/l_{SAT,3}=29$, we have from condition (76) the first approximation:

$$T_{SAT} \approx 29 T_3 \tag{78}$$

denoting that 29 circulations of the Earth (around the combined mass center of the Sun and Saturn) correspond approximately to 1 circulation of Saturn (and the Sun) around the combined mass center of the Sun and Saturn. The first approximation gives the first approximate time periodicity $(T_{SAT,3})_1=29$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of Saturn and the Sun owing to the gravitational interaction of the Sun with Saturn.

Considering the second approximation of the ratio $T_{SAT}/T_3$ given by the following rational number

$$\frac{m_{3,SAT}}{l_{SAT,3}} = 29 + \frac{1}{2} = \frac{59}{2}, \tag{79}$$

we have from condition (76) the second approximation:

$$2T_{SAT} \approx 59 \ T_3 \tag{80}$$

denoting that 59 circulations of the Earth (around the combined mass center of the Sun and Saturn) correspond approximately to 2 circulations of Saturn (and the Sun) around the combined mass center of the Sun and Saturn. The second approximation (80) gives the second approximate time periodicity $(T_{SAT,3})_2=59$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the second approximation) on the Earth of Saturn and the Sun owing to the gravitational interaction of the Sun with Saturn.

Considering the third approximation of the ratio $T_{SAT}/T_3$ given by the following rational number

$$\frac{m_{3,SAT}}{l_{SAT,3}} = 29 + \cfrac{1}{2 + \cfrac{1}{4}} = \frac{265}{9}, \tag{81}$$

we have from condition (76) the third approximation:

$$9T_{SAT} \approx 265 T_3 \tag{82}$$

denoting that 265 circulations of the Earth (around the combined mass center of the Sun and Saturn) correspond approximately to 9 circulations of Saturn (and the Sun) around the combined mass center of the Sun and Saturn. The third approximation (82) gives the third approximate time periodicity $(T_{SAT,3})_3$=265 years of the maximal combined (instantaneous or integral) energy gravitational influences (in the third approximation) on the Earth of Saturn and the Sun owing to the gravitational interaction of the Sun with Saturn.

Thus, considering the different approximations of the ratio $T_{SAT}/T_3$, we obtained the successive approximations for the time periodicities [19]:

$$(T_{SAT,3})_1 = 29 \text{ years}, \tag{83}$$

$$(T_{SAT,3})_2 = 59 \text{ years}, \tag{84}$$

$$(T_{SAT,3})_3 = 265 \text{ years} \tag{85}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of Saturn and the Sun (owing to the gravitational interaction of the Sun with Saturn) in the first, second and third approximations, respectively.

*3.3.1.3 The time periodicity of the maximal energy gravitational influences on the Earth of Uranus and the Sun owing to the gravitational interaction of the Sun with Uranus*

If the configuration of the Earth, Uranus and the Sun is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of Uranus and the Sun (owing to the gravitational interaction of the Sun with Uranus), then the Earth, Uranus and the Sun will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth, Uranus and the Sun considered as the closed system) after $w_{U,3}$ circulations of Uranus (and the Sun) around the combined mass center of the Sun and Uranus and $m_{3,U}$ circulations of the Earth around the combined mass center of the Sun and Uranus) to satisfy the following condition [19]:

$$w_{U,3} T_U = m_{3,U} T_3. \tag{86}$$

Following the known method [49], we present the ratio $T_U/T_3$ by the following mathematical fraction:

$$m_{3,U} / w_{U,3} = \frac{T_U}{T_3} = \frac{30685}{365.3} = 83 + \cfrac{1}{1 + \cfrac{1}{1825 + \cfrac{1}{2}}}. \tag{87}$$

Considering the first approximation of the ratio $T_U/T_3$ given by the rational number $m_{3,U}/w_{U,3}$=84, we have from condition (86) the first approximation:

$$T_U \approx 84\ T_3 \tag{88}$$

denoting that 84 circulations of the Earth (around the combined mass center of the Sun and Uranus) correspond approximately to 1 circulation of Uranus (and the Sun) around the combined mass center of the Sun and Uranus. The first approximation gives the first approximate time periodicity $(T_{U,3})_1$=84 years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of Uranus and the Sun owing to the gravitational interaction of the Sun with Uranus. Thus, considering the first approximation of the ratio $T_U/T_3$, we obtained the first approximation for following time periodicity [19]:

$$(T_{U,3})_1 = 84 \text{ years}, \tag{89}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of Uranus and the Sun (owing to the gravitational interaction of the Sun with Uranus) in the first approximation.

*3.3.1.4 The time periodicities of the maximal energy gravitational influences on the Earth of Neptune and the Sun owing to the gravitational interaction of the Sun with Neptune*

If the configuration of the Earth, Neptune and the Sun is characterized at any time moment by the maximal (instantaneous or integral) combined energy gravitational influences on the Earth of Neptune and the Sun (owing to the gravitational interaction of the Sun with Neptune), then the Earth, Neptune and the Sun will have the recurrence of the same configuration (in the frame of the real elliptical orbits of the Earth, Neptune and the Sun considered as the closed system) after $p_{N,3}$ circulations of Neptune (and the Sun) around the combined mass center of the Sun and Neptune and $m_{3,N}$ circulations of the Earth around the combined mass center of the Sun and Neptune to satisfy the following condition [19]:

 

$$p_{N,3} T_N = m_{3,N} T_3. \tag{90}$$

Following the known method [49], we present the ratio $T_N/T_3$ by the following mathematical fraction:

$$m_{3,N} / p_{N,3} = \frac{T_N}{T_3} = \frac{60189}{365.3} = 164 + \cfrac{1}{1 + \cfrac{1}{3 + \cfrac{1}{3 + \cfrac{156}{233}}}}. \tag{91}$$

Considering the first approximation of the ratio $T_N/T_3$ given by the rational number $m_{3,N}/p_{N,3}=165$, we have from condition (90) the first approximation:

$$T_N \approx 165\, T_3 \tag{92}$$

denoting that 165 circulations of the Earth (around the combined mass center of the Sun and Neptune) correspond approximately to 1 circulation of Neptune (and the Sun) around the combined mass center of the Sun and Neptune. The first approximation gives the first approximate time periodicity $(T_{N,3})_1=165$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the first approximation) on the Earth of Neptune and the Sun owing to the gravitational interaction of the Sun with Neptune.

Considering the second approximation of the ratio $T_N/T_3$ given by the following rational number

$$m_{3,N} / p_{N,3} = 164 + \cfrac{1}{1 + \cfrac{1}{3}} = \frac{659}{4}, \tag{93}$$

we have from condition (90) the second approximation:

$$4T_N \approx 659 T_3 \tag{94}$$

denoting that 659 circulations of the Earth (around the combined mass center of the Sun and Neptune) correspond approximately to 4 circulations of Neptune (and the Sun) around the combined mass center of the Sun and Neptune. The second approximation (94) gives the second approximate time periodicity $(T_{N,3})_2=659$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the second approximation) on the Earth of Neptune and the Sun owing to the gravitational interaction of the Sun with Neptune.

Considering the third approximation of the ratio $T_N/T_3$ given by the following rational number

$$m_{3,N} / p_{N,3} = 164 + \cfrac{1}{1 + \cfrac{1}{3 + \cfrac{1}{3}}} = \frac{2142}{13}, \tag{95}$$

we have from condition (90) the third approximation:

$$13T_N \approx 2142\ T_3 \tag{96}$$

denoting that 2142 circulations of the Earth (around the combined mass center of the Sun and Neptune) correspond approximately to 13 circulations of Neptune (and the Sun) around the combined mass center of the Sun and Neptune. The third approximation (96) gives the third approximate time periodicity $(T_{N,3})_3=2142$ years of the maximal (instantaneous or integral) combined energy gravitational influences (in the third approximation) on the Earth of Neptune and the Sun owing to the gravitational interaction of the Sun with Neptune. Thus, considering the different approximations of the ratio $T_N/T_3$, we obtained the successive approximations for the time periodicities [19]:

$$(T_{N,3})_1 = 165 \ \text{ years}, \tag{97}$$

$$(T_{N,3})_2 = 659 \ \text{ years}, \tag{98}$$

$$(T_{N,3})_3 = 2142 \ \text{ years} \tag{99}$$

of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of Neptune and Sun (owing to the gravitational interaction of the Sun with Neptune) in the first, second and third approximations, respectively.

### 3.3.2 The fundamental global time periodicities of the periodic global seismotectonic, volcanic and climatic activity of the Earth

We expand in this Section the results of the Section 4.4.3 (of the article [18]) by considering the established [19] fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic (and volcanic) activity and the global climate variability induced by the different combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune. It was founded [6-8, 18-21] that the time periodicities of the Earth's global climate variability are determined by the combined cosmic factors: G-factor related with the combined cosmic non-stationary energy gravitational influences on the Earth, G($a$)-factor related with the tectonic-endogenous heating of the Earth as a consequence of the periodic continuum deformation of the Earth due to the G-factor, G($b$)-factor related with the periodic atmospheric-oceanic warming or cooling as a consequence of the periodic variable (increasing or decreasing) output of the heated greenhouse volcanic gases and the related variable greenhouse effect induced by the periodic variable tectonic-volcanic activity (activization or weakening) due to the G-factor, G($c$) -factor related to the periodic variations of the solar activity owing to the periodic variations of the combined planetary non-stationary energy gravitational influence on the Sun. We consider in this Section the combined G, G($a$) and G($b$) cosmic factors related with the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune.

We take into account the established successive approximations for the commensurable [50] time periodicities of recurrence of the maximal (instantaneous and integral) energy gravitational influences on the Earth: $\{(\mathrm{T_{S\text{-}MOON,3}})_\mathrm{i}\}$ =3 years (i=1), 8 years (i=2), the Metonic cycle of 19 years (i=3), 27 years (i=4) for the system Sun-Moon [6-8, 18]; $\{(\mathrm{T_{V,3}})_\mathrm{j}\}$ =3 years (j=1), 8 years (j=2) for Venus [6-8, 18]; $\{(\mathrm{T_{MARS,3}})_\mathrm{k}\}$ =15 years (k=1), 32 years (k=2), 47 years (k=3) for Mars [6-8, 18]; $\{(\mathrm{T_{J,3}})_\mathrm{n}\}$ =11 years (n=1), 12 years (n=2), 83 years (n=3) for Jupiter [6-8, 18] and for the Sun owing to the gravitational interaction of the Sun with Jupiter [19, 20]; $\{(\mathrm{T_{SAT,3}})_\mathrm{m}\}$ =29 years (m=1), 59 years (m=2), 265 years (m=3) for Saturn [19, 20] and for the Sun owing to the gravitational interaction of the Sun with Saturn [19, 20]; $\{(\mathrm{T_{U,3}})_\mathrm{q}\}$ =84 years (q=1) for Uranus [19, 20] and for the Sun owing to the gravitational interaction of the Sun with Uranus [19, 20]; $\{(\mathrm{T_{N,3}})_\mathrm{r}\}$ =165 years (r=1), 659 years (r=2), 2142 years (r=3) for Neptune [19, 20] and for the Sun owing to the gravitational interaction of the Sun with Neptune [19, 20].

Based on the generalized formulation (19) of the first law of thermodynamics used for the Earth as a whole, we founded [19, 20] (taking into account the established [6-8] cosmic G-factor and G($b$)-factor) the fundamental sets of the fundamental global seismotectonic and volcanic time periodicities $\mathrm{T_{tec,f}}$ (of the periodic global seismotectonic and volcanic activities owing to the G-factor) and the fundamental global climatic periodicities $\mathrm{T_{clim1,f}}$ (of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources owing to the G($b$)-factor):

$$\begin{aligned}\mathrm{T_{tec,f}} &= \mathrm{T_{clim1,f}} = \mathrm{T_{energy,f}} \\ &= L.C.M.\left\{(\mathrm{T_{S\text{-}MOON,3}})_\mathrm{i}^{l_0},(\mathrm{T_{V,3}})_\mathrm{j}^{l_2},(\mathrm{T_{MARS,3}})_\mathrm{k}^{l_4},(\mathrm{T_{J,3}})_\mathrm{n}^{l_5},(\mathrm{T_{SAT,3}})_\mathrm{m}^{l_6},(\mathrm{T_{U,3}})_\mathrm{q}^{l_7},(\mathrm{T_{N,3}})_\mathrm{r}^{l_8}\right\}\end{aligned} \tag{100}$$

determined by the successive global fundamental periodicities $\mathrm{T_{energy,f}}$ (defined by the least common multiples $L.C.M.$ of various successive time periodicities related to the different combinations of the following integer numbers: i=1, 2, 3, 4; j=1, 2; k=1, 2, 3; n=1, 2, 3; m=1, 2, 3; q=1; r=1, 2, 3; $l_0$=0,1; $l_2$=0,1; $l_4$=0,1; $l_5$=0,1; $l_6$=0,1; $l_7$=0,1; $l_8$=0,1) of recurrence of the maximal combined energy gravitational influences on the Earth of the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter, Saturn, Uranus and Neptune.

Based on the generalized formulation (19) of the first law of thermodynamics used for the Earth as a whole, we founded [19, 20] (taking into account the established [6-8] cosmic G-factor and the G($a$) and G($b$)-factors) the fundamental set of the fundamental global climatic periodicities (of the periodic global climate variability and the global variability of the quantities of the fresh water and glacial ice resources related with the periodic tectonic-endogenous heating and related global volcanic activity)

$$\begin{aligned} \mathrm{T}_{\text{tec-endog,f}} = \quad & \mathrm{T}_{\text{clim2,f}} = \mathrm{T}_{\text{endog,f}} = \mathrm{T}_{\text{energy,f}} / 2 \\ & = \frac{1}{2} L.C.M.\{(\mathrm{T}_{\text{S-MOON,3}})_{\mathrm{i}}^{l_0}, (\mathrm{T}_{\mathrm{V,3}})_{\mathrm{j}}^{l_2}, (\mathrm{T}_{\text{MARS,3}})_{\mathrm{k}}^{l_4}, (\mathrm{T}_{\mathrm{J,3}})_{\mathrm{n}}^{l_5}, (\mathrm{T}_{\text{SAT,3}})_{\mathrm{m}}^{l_6}, (\mathrm{T}_{\mathrm{U,3}})_{\mathrm{q}}^{l_7}, (\mathrm{T}_{\mathrm{N,3}})_{\mathrm{r}}^{l_8}\} \end{aligned} \tag{101}$$

determined by the G($a$) and G($b$)-factors related to the different combined combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter, Saturn, Uranus and Neptune.

We deduced [19, 20] from formula (100) (for $l_0$=1, $l_2$=1, $l_4$=1, $l_5$=1, $l_6$=1, $l_7$=0, $l_8$=0) the fundamental global seismotectonic, volcanic and climatic periodicity (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn)

$$\mathrm{T}_{\text{tec, f}} = \mathrm{T}_{\text{clim1, f}} = \mathrm{T}_{\text{energy, f}} = L.C.M.\{3, 3, 15, 12, 59\} = 3 \times 5 \times 4 \times 59 \text{ years} = 3540 \text{ years.} \tag{102}$$

We obtained [19, 20] from formula (100) (for $l_0$=1, $l_2$=1, $l_4$=1, $l_5$=1, $l_6$=1, $l_7$=0, $l_8$=0) the fundamental global seismotectonic, volcanic and climatic periodicity (of the Earth's periodic global seismotectonic and volcanic activity and the global climate variability)

$$\mathrm{T}_{\text{tec, f}} = \mathrm{T}_{\text{clim1, f}} = \mathrm{T}_{\text{energy, f}} = L.C.M.\{8, 8, 15, 12, 29\} = 5 \times 696 \text{ years} = 3480 \text{ years} \tag{103}$$

determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn. The time periodicities (102) and (103) give the range [20] of the following fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\text{tec,f}}=\mathrm{T}_{\text{clim1,f}}$ (determined by the G-factor related with the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn):

$$\mathrm{T}_{\text{tec, f}} = \mathrm{T}_{\text{clim1, f}} = \mathrm{T}_{\text{energy, f}} = 3480 \div 3540 \text{ years } = 5(696 \div 708) = (3510 \pm 30) \text{ years.} \tag{104}$$

We deduced [19, 20] from the formula (100) (for $l_0$=1, $l_2$=1, $l_4$=0, $l_5$=1, $l_6$=1, $l_7$=0, $l_8$=0) the range of the following fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\text{tec,f}}=\mathrm{T}_{\text{clim1,f}}$ (determined by the G-factor related with the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn):

$$\begin{aligned} \mathrm{T}_{\text{tec, vol, clim, f}} & = \mathrm{T}_{\text{tec, f}} = \mathrm{T}_{\text{clim1, f}} \\ & = (L.C.M.\{3, 8, 12, 29\} \div L.C.M.\{3, 3, 12, 59\}) = 696 \div 708 \text{ years,} \end{aligned} \tag{105}$$

which contains the empirical time periodicity 704 years [44] of the global seismotectonic activity. The founded range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\text{tec,f}}=\mathrm{T}_{\text{clim1,f}}$=696÷708 years [19, 20] contains the evaluated (based on the wavelet analysis) time periodicity of approximately 700 years [51] characterizing the regional climate variability of the Japan Sea. These agreements with the empirical results [44, 51] confirm the established cosmic energy gravitational genesis of the founded range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities of the global seismotectonic, volcanic and climatic activity of the Earth. The range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities $\mathrm{T}_{\text{tec,f}}=\mathrm{T}_{\text{clim1,f}}$=696÷708 years gives the mean fundamental global seismotectonic, volcanic and climatic periodicity (determined by the G-factor related with the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn)

$$\left\langle \mathrm{T}_{\text{tec, f}} \right\rangle = \left\langle \mathrm{T}_{\text{clim1, f}} \right\rangle = 702 \text{ years} \tag{106}$$

which is the mean value of the empirical seismotectonic periodicity 704 years [44] and the empirical climatic periodicity 700 years [51]. Since the ratio $\left\langle \mathrm{T}_{\text{tec, f}} \right\rangle / (\mathrm{T}_{\text{MARS,3}})_1 = 46.8$ is near the integer number 47 and the ratio $\left\langle \mathrm{T}_{\text{tec, f}} \right\rangle / (\mathrm{T}_{\text{MARS,3}})_2 = 21.937$ is near the integer number 22, we concluded [20] that the time periodicities (105) are determined also by the contribution of the non-stationary energy gravitational influence of Mars on the Earth.

We obtained [20] (for $l_0$=1, $l_2$=1, $l_4$=0, $l_5$=1, $l_6$=0, $l_7$=0, $l_8$=0) from the formula (100) the following fundamental global seismotectonic, volcanic and climatic periodicity $T_{tec,f}=T_{clim1,f}$ (determined by the G-factor related with the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter):

$$T_{tec,\,f} = T_{clim1,\,f} = L.C.M.\{8, 8, 11\} = L.C.M.\{8, 11, 11\} = L.C.M.\{11, 8, 11\} = 88 \text{ years}, \tag{107}$$

which is in agreement with the empirical time periodicity 88 years [44] of the global seismotectonic activity of the Earth and with the climatic periodicity 88 years [52]. This good agreement (of the empirical seismotectonic [44] periodicity 88 years, the empirical climatic [52] periodicity 88 years, and the fundamental global seismotectonic, volcanic and climatic periodicity (107)) confirms additionally the validity of the thermohydrogravidynamic theory [19, 20] of the global seismotectonic, volcanic and climatic activity of the Earth. We established [20] that the range of the fundamental global seismotectonic, volcanic and climatic periodicities (105) contains approximately 8 cycles of the fundamental global seismotectonic, volcanic and climatic periodicity (107). Based on the fundamental global seismotectonic, volcanic and climatic periodicity (107), we predicted [7, 8] “the time range

$$2010 \div 2011 \text{ AD } (1927+83 \div 1923+88) \tag{108}$$

of the next sufficiently strong Japanese earthquake near the Tokyo region”. The 9.0-magnitude strongest (in 2011 and in the modern history of Japan) Japanese earthquake (occurred on 11 March, 2011 near the east coast of Honshu) was realized during the predicted time range 2010÷2011 AD [7, 8]. We concluded [18] that this 9.0-magnitude strongest Japanese earthquake confirmed the proposed cosmic energy gravitational genesis [6-8] of the strongest Japanese earthquakes.

# 4 The Confirmation of the Thermohydrogravidynamic Theory Concerning the Validity of the Previously Established First Forthcoming Subrange (2023 ± 3) AD

## 4.1 The Linkage of the Greatest Earthquake Destroyed the Ancient Pontus (63 BC) and the Great Earthquakes Occurred in England (1318 AD and 1343 AD)

Using the time differences 1381 years (1318 + 63) between the great earthquake [16] occurred in England (1318 AD) and the greatest earthquake occurred in the ancient Pontus (63 BC [30]), we obtained [19] the ratio:

$$\frac{(1318+63) \text{ years}}{696 \text{ years}} = \frac{1381}{696} = 1.9842, \tag{109}$$

which shows that we have approximately 2 time periods of 696 years (given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) between these great earthquakes occurred in the ancient Pontus (63 BC), in England (1318 AD) and in Armenia (1319 AD [16]). Using the time difference 1406 years (1343 + 63) between the great earthquake occurred in England (1343 AD [16]) and the greatest earthquake occurred in the ancient Pontus (63 BC), we obtained [19] the ratio:

$$\frac{(1343+63) \text{ years}}{696 \text{ years}} = \frac{1406}{696} = 2.0201, \tag{110}$$

which shows that we have approximately 2 time periods of 696 years between these great earthquakes.

Using the mean date 1330.5 AD between the great earthquakes occurred in England (1318 AD and 1343 AD [16]) and the greatest earthquake occurred in the ancient Pontus (63 BC), we obtained [19] the ratio:

$$\frac{(1330.5+63) \text{ years}}{696 \text{ years}} = \frac{1393.5}{696} = 2.0021, \tag{111}$$

which shows that the great earthquakes in England (1318 AD and 1343 AD) occurred approximately after 2 time periods of 696 years (given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) from the date 63 BC of the greatest earthquake in the ancient Pontus.

Using the mean date 1332 AD between the great earthquakes occurred in Portugal (1320 AD and 1344 AD [16]) and the greatest earthquake occurred in the ancient Pontus (63 BC), we obtained [19] the ratio:

$$\frac{(1332 + 63) \text{ years}}{696 \text{ years}} = \frac{1395}{696} = 2.0043, \tag{112}$$

which shows that the great earthquakes in Portugal (1320 AD and 1344 AD) occurred approximately after 2 time periods of 696 years (given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) from the date 63 BC of the greatest earthquake in the ancient Pontus.

We concluded [19] that the closeness of the ratios (109), (110), (111) and (112) to the integer number 2 (for England and Portugal) confirms the founded cosmic energy gravitational genesis of the fundamental global seismotectonic, volcanic and climatic periodicity 696 years (given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities [19]) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn.

Based on the established evidence [20] of the founded [19] range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities, we can conclude that the closeness of the ratios (109), (110), (111) and (112) to the integer number 2 (for England and Portugal) means really the established [19] strong linkage (correlation) between the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes [16] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD) and Portugal (1320 AD and 1344 AD). Using the mean date 1330.5 AD between the great earthquakes occurred in England (1318 AD and 1343 AD [16]) and the greatest earthquake occurred in the ancient Pontus (63 BC [30]), we get the ratio:

$$\frac{(1330.5 + 63) \text{ years}}{(702 \pm 6) \text{ years}} = 1.968220 \div 2.002155 = 1.985042 \pm 0.017, \tag{113}$$

which shows that the great earthquakes in England (1318 AD and 1343 AD) occurred approximately after 2 time periods (105) (of the fundamental global seismotectonic, volcanic and climatic periodicities) from the date 63 BC of the greatest earthquake occurred in the ancient Pontus. The closeness of the ratio (113) to the integer number 2 (for England) confirms really the established [19] strong linkage (correlation) between the greatest earthquake destroyed the ancient Pontus (63 BC) and the great earthquakes occurred in England (1318 AD and 1343 AD).

### 4.2 The Linkage of the Planetary Disasters Occurred in the Central Asia (10555 BC), in the Ancient Egyptian Kingdom (10450 BC) and the Greatest Earthquake Destroyed the Ancient Pontus (63 BC)

Using the time duration 10439.5 years (10502.5 - 63) between the greatest Pontic earthquake (63 BC [30]) occurred in Asia Minor and the obtained mean estimation 10502.5 BC ((10555+10450)/2) of the planetary disaster (10555 BC) occurred in the Central Asia [31] and the planetary disaster (10450 BC) occurred in the ancient Egyptian Kingdom [32], we obtained [19] the ratio

$$\frac{(10502.5\text{-}63) \text{ years}}{696 \text{ years}} = \frac{10439.5}{696} = 14.9992 \approx 15, \tag{114}$$

confirming the fundamental global seismotectonic, volcanic and climatic periodicity 696 years (given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn.

We obtained [19] also the ratio

$$\frac{(10502.5\text{-}63) \quad \text{years}}{3480 \text{ years}} = \frac{10439.5}{3480} \approx \frac{10440}{3480} = \frac{3 \times 3480}{3480} = 3, \tag{115}$$

confirming the fundamental global seismotectonic, volcanic and climatic periodicity 3480 years (given by the lower boundary of the range (104) of the fundamental global seismotectonic, volcanic and climatic periodicities) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn.

We concluded [19] that the obtained rations (114) and (115) confirm the fundamental global seismotectonic, volcanic and climatic periodicities 696 years and 3480 years determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn. Based on the established evidence [20] of the founded [19] ranges (104) and (105) of the fundamental global seismotectonic, volcanic and climatic periodicities, we can conclude that the closeness of the ratios (114) and (115) to the integer numbers 15 and 3 (respectively) means really the established [19] strong linkage (correlation) between the planetary disasters occurred in the Central Asia (10555 BC [31]) and in the ancient Egyptian Kingdom (10450 BC [32]), and the greatest earthquake destroyed the ancient Pontus (63 BC [30]). Using the time duration (10521±36) years (10584 ±36 - 63) between the greatest Pontic earthquake (63 BC [30]) occurred in Asia Minor and the obtained [20] estimation (10584 ±36) BC of the planetary disaster, we get the ratio

$$\frac{(10584 \pm 36\text{-}63) \quad \text{years}}{702 \text{ years}} = \frac{10521 \pm 36}{702} = 14.987179 \pm 0.051282 \approx 15, \tag{116}$$

confirming the fundamental global seismotectonic, volcanic and climatic periodicity 702 years (given by the mean value (106) of the range (105) (of the fundamental global seismotectonic, volcanic and climatic periodicities) determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn. The closeness of the ratio (116) to the integer number 15 means really the strong linkage (correlation) between the planetary disaster (realized during the estimated range (10584 ±36) BC [20]) and the greatest earthquake destroyed the ancient Pontus (63 BC [30]). Based on the established (on October, 2012 [53]) range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities, we established (on October, 2012 [53]) "the range $2020 \div 2061\,\text{AD}$ of the maximal seismotectonic, volcanic and climatic activities of the Earth in the 21$^{st}$ century".

### 4.3 The Established First Forthcoming Subrange (2023±3) AD of the Increased Intensification of the Global Seismotectonic, Volcanic and Climatic Activity of the Earth

Considering the date (63 BC [30]) of the greatest earthquake destroyed the ancient Pontus, we evaluated (based on the founded time periodicity 696 years given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) the approximate date of the next maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with Jupiter and Saturn) [19]

$$-63 \text{ years} + 1 \times 696 \text{ years} = 633 \text{ AD}, \tag{117}$$

which is very close to the date 626 AD of the recorded atmospheric veil in Europe [54] and the resulted great frost events in 628 AD [54]. We concluded [19] that this satisfactory agreement shows that these geophysical events are closely correlated.

Considering the date (63 BC [30]) of the greatest earthquake destroyed the ancient Pontus, we evaluated (based on the founded time periodicity 696 years given by the lower boundary of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities) the approximate date of the next maximal global seismotectonic, volcanic and climatic activity of the Earth (determined by the combined predominant non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interactions of the Sun with

 

Jupiter and Saturn) [19]

$$-63 \text{ years } + 2 \times 696 \text{ years } = 1329 \text{ AD}, \tag{118}$$

which is in good agreement with the mean date (1330.5 AD) of the great earthquakes occurred in England (1318 AD and 1343 AD [16]). We concluded [19] that the great earthquake occurred in the ancient Pontus (63 BC [30]) and the great earthquakes occurred in England (1318 AD and 1343 AD [16]) can be considered as the closely related events. We used [19] this fact for evaluation of the first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic and climatic activity of the Earth in the 21st century AD during the past 696÷708 years of the history of humankind. Considering the time range (50±30) BC [48] of the strong global volcanic activity of the Earth, we can evaluate the range of the dates of the possible strong earthquakes and the strong volcanic eruptions (after 2 cycles of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities [19]):

$$-(50 \pm 30) \text{ years } + 2 \times (702 \pm 6) \text{ years } = 1354 \pm 42 \text{ AD} = 1312 \div 1396 \text{ AD}, \tag{119}$$

which includes the dates (1341 AD and 1389 AD) of the volcanic eruptions [55] occurred in Iceland on the Hekla volcanic system, the date (1357 AD) of the volcanic eruption [55] occurred in Iceland on the Katla volcanic system, and the dates of the great earthquakes [16] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD), Portugal (1320 AD, 1344 AD and 1356 AD), Austria (1348 AD) and Japan (1361 AD). We have the difference of 6 years between the date 1318 AD of the first great earthquake [16] occurred in England and the lower date 1312 AD of the range (119). We see that the mean date 1354 AD of the range (119) is in very good agreement with the lower date 1350 AD of the range (1350÷1700) AD of the "Litle Ice Age" [48]. Consequently, we can conclude that the "Litle Ice Age" [48] is induced by the intensification of the volcanic eruptions of the Earth during the range (119).

Based on the founded range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities [19] and considering the date (1318 AD [16]) of the great earthquake occurred in England, we evaluated [19] the following range of the next possible strong seismotectonic (volcanic and climatic) activity in England

$$1318 \text{ years} + 696 \text{ years } \div 1318 \text{ years} + 708 \text{ years} = 2014 \div 2026 \text{ AD}, \tag{120}$$

which gives the mean date [19]

$$(1318 + 702) \text{ AD} = (2014 + 2026 \text{ AD})/2 = 2020 \text{ AD} \tag{121}$$

of the initial phase of the rapid increase of the global seismotectonic and volcanic activities and the climate variability of the Earth in the 21st century. Considering the range of the possible dates (1450±14) BC [20] of the last major eruption of Thera [56], we evaluated [20] the range of the dates of the possible intensification of volcanic and seismic activity (after 5 cycles of the fundamental global periodicities (105) or after 1 cycle of the fundamental global periodicities (104)):

$$-(1450 \pm 14) + 5 \times (702 \pm 6) = (2060 \pm 44) \text{AD} = (2016 \div 2104) \text{ AD}. \tag{122}$$

We evaluated [19] (based on estimations (120) and (121)) the more narrow first forthcoming subrange (of the increased global seismotectonic and volcanic activity and the climate variability of the Earth in the 21st century)

$$2020 \div 2026 \text{ AD} = 2023 \pm 3 \text{ AD} \tag{123}$$

determined by the time periodicity $\{(\mathrm{T}_{\text{S-MOON},3})_1\} = 3$ years of recurrence of the maximal (instantaneous and integral) combined energy gravitational influences on the Earth of the system Sun-Moon and Venus.

Considering the time range (50±30) BC [48] of the strong global volcanic activity of the Earth, we evaluate the range of the dates of the possible strong earthquakes and the strong volcanic eruptions (after 3 cycles of the range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities):

$$-(50 \pm 30) \text{ years} + 3 \times (702 \pm 6) \text{ years} = 2056 \pm 48 \text{ AD} = 2008 \div 2104 \text{ AD}, \tag{124}$$

which includes the date (2011 AD) of the 9.0-magnitude (strongest in 2011 and in the modern history of Japan) Japanese earthquake occurred on 11 March, 2011 near the east coast of Honshu. We have the difference of 7 years between the date 2015 AD of the strongest (in the modern history of England) flood occurred in England and the lower date 2008 AD of the range (124). This difference of 7 years (for England) is in good agreement with the established above difference of 6 years (for England) between the date 1318 AD of the first great earthquake [16] occurred in England and the lower date 1312 AD of the obtained range (119).

Based on the established range [7] of the seismotectonic, volcanic, climatic and magnetic time periodicities (determined by the Chandler's wobble of the Earth's pole [57])

$$T_{Ch} = 405 \div 447.25 \text{ days} \tag{125}$$

and the related range [7, 58] of the seismotectonic, volcanic, climatic and magnetic time periodicities (determined by the periodic tectonic-endogenous heating of the Earth owing to the periodic Earth's continuum deformation [7])

$$T_{Ch} / 2 = 202.5 \div 223.625 \text{ days} = 0.5541 \div 0.61225 \text{ years}, \tag{126}$$

we obtained [58] the mean seismotectonic, volcanic, climatic and magnetic time periodicity

$$\left\langle T_{Ch} / 2 \right\rangle = (202.5 + 223.625) / 2 \text{ days} = 213.0625 \text{ days} = 0.58333 \text{ years}. \tag{127}$$

Considering the Japanese powerful 7.8-magnitude (strongest in the range from 1 January, 2015 to 30 May, 2015) earthquake (occurred on 30 May, 2015 near the Tokyo region), we evaluated (on 22 October, 2015 [58]) the temporal center (corresponding to (27.5±0.5) December, 2015)

$$\left\langle t_{int} \right\rangle = 2015.994 \text{ years} \tag{128}$$

of the next possible intensifications (corresponding to (27.5±0.5) December, 2015) of the global natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth. Based on the established [7] range (126), we evaluated (on 22 October, 2015 [58]) the range $t_{int}$ of the possible intensifications of the global natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth [58]:

$$t_{int} = 2015.96508 \div 2016.02292 \text{ years}, \tag{129}$$

which corresponds to the range from 18 December, 2015 to 9 January, 2016. We considered [58] the range (129) as the first candidate of the possible burst of the next active intensifications (near 2016) of the global natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth. We established [21] that the center ((27.5±0.5) December, 2015) of the range (129) is very close to the date 26 December, 2015 of the strongest flood occurred in England. We see also that the date 26 December, 2015 of the strongest (in the modern history of England) flood occurred in England is in good agreement with the lower date 2014 AD of the predicted (in 2012 AD [19] for England) range (120). This result shows clearly that the England (considered as an island) will be vulnerable definitely during the first forthcoming subrange (123) of the increased intensification of the global seismotectonic and volcanic activity and the climate variability of the Earth in the 21st century.

### 4.4 The Forthcoming Dates 2021.1 AD and 2021.65 AD Corresponding to the Maximal and Minimal Combined Cosmic Integral Energy Gravitational Influences on the Earth

To determine the forthcoming dates $t^*(\tau_{c,r}, 2021) = 2021.1$ AD and $t_*(\tau_{c,r}, 2021) = 2021.65$ AD corresponding to the maximal and minimal (respectively) combined planetary and solar integral energy gravitational influences on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) during the established first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth, we use the global prediction thermohydrogravidynamic principles [19, 20] determining the maximal temporal intensifications of the global natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth. Taking into account the general relation (13) for the infinitesimal energy gravitational influence dG on the individual finite continuum region $\tau$, we obtained [20] the following relation for the combined differential cosmic non-stationary energy gravitational influence $dG(\tau_{c,r})$ (during the infinitesimal time dt) of the Solar System (the planets, the Moon and the Sun owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune) on the internal rigid core $\tau_{c,r}$ of the Earth:

$$dG(\tau_{c,r}) = dt \iiint_{\tau_{c,r}} \frac{\partial \psi_{comb}}{\partial t} \rho_{c,r} dV, \tag{130}$$

where $\rho_{c,r}$=12800 kg·m$^{-3}$ [59] is the mass density of the internal rigid core $\tau_{c,r}$, $\partial\psi_{comb}/\partial t \equiv \partial\psi_{comb}(\tau_{c,r}, t)/\partial t$ is the partial derivative (of the combined cosmic gravitational potential $\psi_{comb} \equiv \psi_{comb}(\tau_{c,r}, t)$ in the internal rigid core $\tau_{c,r}$ of the Earth) approximated as follows

 

$$\frac{\partial\psi_{\mathrm{comb}}(\tau_{\mathrm{c,r}},\mathrm{t})}{\partial\mathrm{t}}=\frac{\partial\psi_{\mathrm{3MOON}}(\mathrm{C}_3,\mathrm{t})}{\partial\mathrm{t}}+\sum_{\mathrm{i=1,i\neq3}}^{9}\frac{\partial\psi_{\mathrm{3i}}(\mathrm{C}_3,\mathrm{t})}{\partial\mathrm{t}}+\sum_{\mathrm{j=5}}^{8}\frac{\partial\psi_{\mathrm{3j}}^{\mathrm{S}}(\mathrm{C}_3,\mathrm{t})}{\partial\mathrm{t}}. \tag{131}$$

Here $\partial\psi_{\mathrm{3MOON}}(\mathrm{C}_3,\mathrm{t})/\partial\mathrm{t}$ is the partial derivative [7, 8, 18, 19] of the gravitational potential $\psi_{\mathrm{3MOON}}(\mathrm{C}_3,\mathrm{t})$ created by the Moon at the mass center $C_3$ of the Earth; $\partial\psi_{\mathrm{3i}}(\mathrm{C}_3,\mathrm{t})/\partial\mathrm{t}$ is the partial derivative [6-8, 18, 19] of the gravitational potential $\psi_{\mathrm{3i}}(\mathrm{C}_3,\mathrm{t})$ created by the planet $\tau_i$ at the mass center $C_3$ of the Earth; $\partial\psi_{\mathrm{3j}}^{\mathrm{S}}(\mathrm{C}_3,\mathrm{t})/\partial\mathrm{t}$ is the partial derivative (given by the relation (48)) of the gravitational potential $\psi_{\mathrm{3j}}^{\mathrm{S}}(\mathrm{C}_3,\mathrm{t})$ created by the Sun (due to the gravitational interaction of the Sun with the outer large planet $\tau_j$, j =5, 6, 7, 8) at the mass center $C_3$ of the Earth.

We established [20] that the combined differential cosmic energy gravitational influence per unit time and per unit volume $\mathrm{dG}(\tau_{\mathrm{c,r}})/(\mathrm{dtV}(\tau_{\mathrm{c,r}}))$ on the internal rigid core $\tau_{c,r}$ of the Earth:

$$\frac{\mathrm{dG}(\tau_{\mathrm{c,r}})}{\mathrm{dt}\iiint\limits_{\tau_{\mathrm{c,r}}}\mathrm{dV}}=\frac{\mathrm{dG}(\tau_{\mathrm{c,r}})}{\mathrm{dtV}(\tau_{\mathrm{c,r}})}=\frac{\partial\psi_{\mathrm{comb}}}{\partial\mathrm{t}}\rho_{\mathrm{c,r}} \tag{132}$$

has the maximal absolute value for the internal rigid core $\tau_{c,r}$ of the Earth (from all interior of the Earth):

$$\frac{\left|\mathrm{dG}(\tau_{\mathrm{c,r}})\right|}{\mathrm{dtV}(\tau_{\mathrm{c,r}})}=\left|\frac{\partial\psi_{\mathrm{comb}}}{\partial\mathrm{t}}\right|\rho_{\mathrm{c,r}} \tag{133}$$

since the mass density $\rho_{c,r}$=12800 kg·m$^{-3}$ [59] (of the internal rigid core $\tau_{c,r}$) has the maximal value and the partial derivative $\partial\psi_{\mathrm{comb}}/\partial\mathrm{t}$ is nearly constant value in all interior of the Earth [7, 8]. Taking into account this fact, we concluded [20] about the maximal intensity of the thermohygrogravidynamic processes in the internal rigid core $\tau_{c,r}$ of the Earth (and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth) with respect to others regions of the Earth.

Based on the generalization (19) of the first law of thermodynamics (used for the internal rigid core $\tau_{c,r}$ of the Earth), we formulated [19-21] the global prediction thermohydrogravidynamic principles determining the maximal temporal intensifications of the established thermohygrogravidynamic processes (in the internal rigid core $\tau_{c,r}$ [20] and in the boundary region $\tau_{rf}$ [20] between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ [20] of the Earth considered as a whole [19]) subjected to the combined cosmic energy gravitational influence of the planets of the Solar System, the Moon and the Sun (owing to the gravitational interaction of the Sun with the outer large planets). We concluded [20] (based on the generalization (19) of the first law of thermodynamics used for the internal rigid core $\tau_{c,r}$ of the Earth) that the maximal intensifications of the established thermohygrogravidynamic processes are related with the corresponding maximal intensifications of the global and regional natural (seismotectonic, volcanic and climatic) processes of the Earth.

The rigorous global prediction thermohydrogravidynamic principles (determining the maximal temporal intensifications near the time moments $t=t^*(\tau_{c,r})$ and $t=t_*(\tau_{c,r})$, respectively, of the thermohydrogravidynamic processes in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth) are formulated as follows [20]:

$$\Delta\,\mathrm{G}(\tau_{\mathrm{c,r}},\mathrm{t}^*(\tau_{\mathrm{c,r}}))=\max_{\mathrm{t}}\int_{\mathrm{t}_0}^{\mathrm{t}}\mathrm{dt}'\iiint\limits_{\tau_{\mathrm{c,r}}}\frac{\partial\psi_{\mathrm{comb}}}{\partial\mathrm{t}'}\rho_{\mathrm{c,r}}\mathrm{dV}\ \text{– local maximum for time moment } \mathrm{t}^*(\tau_{\mathrm{c,r}}), \tag{134}$$

and

$$\Delta\,\mathrm{G}(\tau_{\mathrm{c,r}},\mathrm{t}_*(\tau_{\mathrm{c,r}}))=\min_{\mathrm{t}}\int_{\mathrm{t}_0}^{\mathrm{t}}\mathrm{dt}'\iiint\limits_{\tau_{\mathrm{c,r}}}\frac{\partial\psi_{\mathrm{comb}}}{\partial\mathrm{t}'}\rho_{\mathrm{c,r}}\mathrm{dV}\ \text{– local minimum for time moment } \mathrm{t}_*(\tau_{\mathrm{c,r}}). \tag{135}$$

The global prediction thermohydrogravidynamic principles (134) and (135) define the maximal and minimal combined cosmic integral energy gravitational influences ((134) and (135), respectively, for the time moments $t=t^*(\tau_{c,r})$ and $t=t_*(\tau_{c,r})$) on the considered internal rigid core $\tau_{c,r}$ (of the Earth) subjected to the combined cosmic integral energy gravitational influence of the planets of the Solar System, the Moon and the Sun (owing to the gravitational interaction of the Sun with the outer large planets). The formulated [20] global prediction thermohydrogravidynamic principles (134) and (135) are analogous to the established previously global prediction thermohydrogravidynamic principles (69) and (71) [19] formulated for the Earth as a whole. Based on the formulated [20] principles (134) and (135), we founded [20] (not taking into account the gravitational potential $\psi_{3MOON}(C_3,t)$ [7, 8] created by the Moon) the same catastrophic planetary configurations 1 and 2 (shown on Figs. 3 and 4, respectively) characterized by the maximal temporal intensifications of the thermohygrogravidynamic processes (in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth, and consequently, in all geospheres of the Earth including the fluid core $\tau_{c,f}$ of the Earth, the mantle of the Earth and the Earth's crust) related with the maximal temporal intensifications of the global and regional natural (seismotectonic, volcanic and climatic) processes of the Earth.

Based on the rigorous global prediction thermohydrogravidynamic principle (134), we established the confirmed validity [21] of the thermohydrogravidynamic theory concerning the predicted (on 31 August, 2016 based on the real planetary configurations of the Earth and the planets of the Solar System) strongest intensifications of the global natural processes of the Earth in 2016 (since 1 September, 2016 and before 26 January, 2017) determined by the maximal combined integral energy gravitational influence (realized approximately on 6 October, 2016 [21]) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. We established the fact [21] (confirming the validity of the thermohydrogravidynamic theory) that the date of 6 October, 2016 (when "Hurricane Matthew has gained new muscle over the Bahamas" [22]) is in the perfect agreement with the calculated (in advance, on 31 August, 2016) numerical time moment $t^{*}(\tau_{c,r}, 2016) = 2016.7666$ AD (corresponding approximately to 6 October, 2016) of the maximal (in 2016) combined planetary and solar integral energy gravitational influence (134) on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole). We established the second confirmed validity [23] of the prediction of the thermohydrogravidynamic theory (based on the rigorous global prediction thermohydrogravidynamic principle (135)) concerning the first subrange of the strongest intensifications of the global natural processes of the Earth in 2017 (since 10 April, 2017 and before 6 August, 2017) determined by the minimal (near the calculated numerical time moment $t_{*}(\tau_{c,r}, 2017) = 2017.3$ AD corresponding approximately to 20 April, 2017) combined integral energy gravitational influence on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune. We established the third confirmed validity [24] of the predictions (made on August 9, 2017) of the thermohydrogravidynamic theory (based on the rigorous global prediction thermohydrogravidynamic principle (134) and using the real planetary configurations of the Earth and the planets of the Solar System) concerning the predicted strongest intensifications of the seismotectonic and climatic processes in California (since 9 August, 2017 and before 3 March, 2018 [25]) and in Japan (since 24 July, 2017 and before 16 March, 2018 [26]). Based on the rigorous global prediction thermohydrogravidynamic principles (134) and (135), we established [27] the confirmed validity of the cosmic energy gravitational genesis of the strongest Japanese (for 2015 and 2016), Italian (for 2016), Greek (for 2017), Chinese (for 2008 and 2017) and Chilean (for 2015 and 2016) earthquakes related with the extreme (maximal and minimal, respectively) combined integral energy gravitational influences on the internal rigid core $\tau_{c,r}$ of the Earth (and on the Earth as a whole) of the planets (Mercury, Venus, Mars and Jupiter) and the Sun due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune.

Based on the confirmed validity [21, 23-27] of the established [19, 20] global prediction thermohydrogravidynamic principles (134) and (135) of the cosmic seismology, we use the global prediction thermohydrogravidynamic principles (134) and (135) to calculate (based on the real planetary configurations of the Earth and the planets of the Solar System) the numerical time moments related with the maximal and minimal (during the range (2020÷2026) AD) combined planetary and solar integral energy gravitational influences (134) and (135) (respectively) on the internal rigid core $\tau_{c,r}$ (and on the Earth as a whole) during the range (2020÷2026) AD. Based on the global prediction thermohydrogravidynamic principle (134) and considering the real planetary configurations of the Earth and the planets of the Solar System, we obtain (on 30 May, 2018) the numerical time moment:

 

$$t^*(\tau_{c,r}, 2021) = 2021.1 \text{ AD} \tag{136}$$

related with the maximal (during the range (2020÷2026) AD) combined planetary and solar integral energy gravitational influence (134) on the internal rigid core $\tau_{c,r}$ (and on the Earth ($\tau_3$) as a whole).

Based on the global prediction thermohydrogravidynamic principle (135) and considering the real planetary configurations of the Earth and the planets of the Solar System, we obtain (on 30 May, 2018) the numerical time moment:

$$t_*(\tau_{c,r}, 2021) = 2021.65 \text{ AD} \tag{137}$$

related with the minimal (during the range (2020÷2026) AD) combined planetary and solar integral energy gravitational influence (135) on the internal rigid core $\tau_{c,r}$ (and on the Earth as a whole).

### 4.5 The Evaluation of the Maximal Magnitudes of the Strongest Earthquakes of the Earth During the Established First Forthcoming Subrange (2020÷2026) AD

To evaluate the maximal magnitudes of the strongest earthquakes of the Earth during the established first forthcoming subrange (2020÷2026) AD [19, 20] of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth, we consider the strongest earthquakes (according to the U.S. Geological Survey) since 2004 AD and before 2017 AD. We take into account the strongest 9.1-magnitude (according to the U.S. Geological Survey) earthquake, which struck Indonesia, Northern Sumatra on December 26, 2004. We take into account the second strongest 9.0-magnitude (according to the U.S. Geological Survey) earthquake (taken into account for prediction [26] of the strongest intensifications of the seismotectonic and climatic processes in Japan since 24 July, 2017 and before 16 March, 2018 [26]), which struck Japan on March 11, 2011. We take into account also the 8.3-magnitude (according to the U.S. Geological Survey) Chilean earthquake, which struck Chile on September 16, 2015. The first direct detection of the gravitational waves (on September 14, 2015 [28, 29]) occurred after the calculated (based on the global prediction thermohydrogravidynamic principle (134) used for the real planetary configurations of the Earth and the planets of the Solar System) date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD (corresponding approximately to September 6, 2015 of the maximal (in 2015) combined planetary and solar integral energy gravitational influence on the internal rigid core of the Earth) and before the date (September 16, 2015 according to the U.S. Geological Survey) of the strongest (in 2015 according to the U.S. Geological Survey) 8.3-magnitude Chilean earthquake (realized near 10 days after the date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD calculated based on the real planetary configurations of the Earth and the planets of the Solar System).

Based on the confirmed [21, 23-27] global prediction thermohydrogravidynamic principles (134) and (135) of the cosmic seismology [19, 20], we calculate (based on the real planetary configurations of the Earth and the planets of the Solar System) the date $t^*(\tau_{c,r}, 2004) = 2004.6833$ AD (corresponding to the local maximal (for 2004 AD) combined planetary and solar integral energy gravitational influence (134) on the internal rigid core $\tau_{c,r}$ of the Earth) and the date $t_*(\tau_{c,r}, 2004) = 2004.15$ AD corresponding to the local minimal (for 2004 AD) combined planetary and solar integral energy gravitational influence (135) on the internal rigid core $\tau_{c,r}$ of the Earth. Based on the global prediction thermohydrogravidynamic principles (134) and (135), we calculated [26] (based on the real planetary configurations of the Earth and the planets of the Solar System) the date $t^*(\tau_{c,r}, 2011) = 2011.2666$ AD (corresponding to the local maximal (for 2011 AD) combined planetary and solar integral energy gravitational influence (134) on the internal rigid core $\tau_{c,r}$ of the Earth) and the date $t_*(\tau_{c,r}, 2011) = 2011.8166$ AD corresponding to the local minimal (for 2011 AD) combined planetary and solar integral energy gravitational influence (135) on the internal rigid core $\tau_{c,r}$ of the Earth.

Considering the strongest earthquakes (according to the U.S. Geological Survey) since 2004 AD and before 2017 AD, we calculate for 2004 AD (characterized by the strongest 9.1-magnitude earthquake, which struck Indonesia, Northern Sumatra on December 26, 2004) the maximal (for the considered range (2004÷2017) AD since 2004 AD and before 2017 AD) normalized (on the expression (61)) value

$$\Delta_{g,S,P}(2004) = \frac{\Delta G(\tau_{c,r}, t^*(\tau_{c,r}, 2004)) - \Delta G(\tau_{c,r}, t_*(\tau_{c,r}, 2004))}{\Delta_g E_з(\tau_1, 0, 0, t_1^*(1,3), 0)} = 4576.6167. \quad (138)$$

We calculate for 2011 AD (characterized by the second strongest 9.0-magnitude earthquake, which struck Japan on March 11, 2011) the normalized (on the expression (61)) value

$$\Delta_{g,S,P}(2011) = \frac{\Delta G(\tau_{c,r}, t^*(\tau_{c,r}, 2011)) - \Delta G(\tau_{c,r}, t_*(\tau_{c,r}, 2011))}{\Delta_g E_з(\tau_1, 0, 0, t_1^*(1,3), 0)} = 3461.9393, \quad (139)$$

which is smaller than the numerical value (138). According to the global prediction thermohydrogravidynamic principles (134) and (135) of the thermohydrogravidynamic theory, the normalized (on the expression (61)) numerical function of the time t (for the real planetary configurations of the Earth and the planets of the Solar System)

$$\Delta_{g,S,P}(t) = \frac{\Delta G(\tau_{c,r}, t^*(\tau_{c,r}, t)) - \Delta G(\tau_{c,r}, t_*(\tau_{c,r}, t))}{\Delta_g E_3(\tau_1, 0, 0, t_1^*(1,3), 0)} \quad (140)$$

determines (according to the thermohydrogravidynamic theory) the strength of the established [19, 20] thermohygrogravidynamic processes (in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth, and in the Earth as a whole) and related maximal intensifications of the global and regional natural (seismotectonic, volcanic, climatic and magnetic) processes of the Earth.

To predict in advance (on 30 May, 2018) the maximal magnitudes of the strongest earthquakes (during the established [19, 20] first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth), we use the established [19, 20] global prediction thermohydrogravidynamic principles (134) and (135) determining the maximal temporal intensification (near the time moments $t=t^*(\tau_{c,r})$ and $t=t_*(\tau_{c,r})$, respectively) of the thermohydrogravidynamic processes [19, 20] in the internal rigid core $\tau_{c,r}$ and in the boundary region $\tau_{rf}$ between the internal rigid core $\tau_{c,r}$ and the fluid core $\tau_{c,f}$ of the Earth.

Based on the global prediction thermohydrogravidynamic principle (134) and (135) used for the range (2018÷2026) AD we calculate the dates $t^*(\tau_{c,r}, (2004+m))$ and $t_*(\tau_{c,r}, (2004+m))$ (m = 14, 15, ..., 22) corresponding to the different local maximal and minimal values (134) and (135) of the combined planetary and solar integral energy gravitational influences (for the real planetary configurations during the range (2018÷2026) AD) on the internal rigid core $\tau_{c,r}$ and on the Earth $\tau_3$ as a whole. We calculate the maximal (for 2021 AD and for the considered range (2004÷2026) AD) normalized (on the expression (61)) numerical value (taking into account the combined integral energy gravitational influence (on the internal rigid core $\tau_{c,r}$ of the Earth) of the Sun (due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune) and the planets of the Solar System)

$$\Delta_{g,S,P}(2021) = \frac{\Delta G(\tau_{c,r}, t^*(\tau_{c,r}, 2021)) - \Delta G(\tau_{c,r}, t_*(\tau_{c,r}, 2021))}{\Delta_g E_3(\tau_1, 0, 0, t_1^*(1,3), 0)} = 5273.4914, \quad (141)$$

which is larger than the values (138) and (139) for 2004 AD and for 2011 AD, respectively.

Let us evaluate the range

$$M_l(2020 \div 2026) \le M_{st}(2020 \div 2026) \le M_{up}(2020 \div 2026) \quad (142)$$

of the maximal magnitudes $M_{st}(2020 \div 2026)$ of the strongest earthquakes of the Earth during the established [19, 20] first forthcoming subrange (2020÷2026) AD of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth. Taking into account the maximal magnitude $M_{up}(2004)=9.1$ (of earthquakes according to the U.S. Geological Survey) for 2004 AD and the maximal magnitude $M_{up}(2011)=9.0$ (of earthquakes according to the U.S. Geological Survey) for 2011 AD, we evaluate (based on the linear extrapolation) the lower boundary $M_l(2020 \div 2026)$ of the maximal magnitudes $M_{st}(2020 \div 2026)$ of the strongest earthquakes of the Earth during the range (2020÷2026) AD:

$$M_l(2020 \div 2026) = M_{up}(2011) + \frac{M_{up}(2004) - M_{up}(2011)}{\Delta_{g,S,P}(2004) - \Delta_{g,S,P}(2011)}(\Delta_{g,S,P}(2021) - \Delta_{g,S,P}(2011)) = 9.1625. \quad (143)$$

To evaluate the upper boundary $M_{up}(2020 \div 2026)$ of the maximal magnitudes (in the range (142)) of the strongest earthquakes of the Earth during the range (2020÷2026) AD, we consider the strongest (in 2015 according to the U.S. Geological Survey) 8.3-magnitude Chilean earthquake (realized on September 16, 2015 after 2 days of the first direct detection of gravitational waves (on September 14, 2015 [28, 29]) and near 10 days after the calculated (based on the global prediction thermohydrogravidynamic principle (134) used for the real planetary configurations of the Earth and the planets of the Solar System [27]) date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD corresponding to the maximal (in 2015 AD) combined planetary and solar integral energy gravitational influence on the internal rigid core of the Earth. We calculate the maximal (for 2015 AD) normalized (on the expression (61)) numerical value (taking into account the combined integral energy gravitational influence (on the internal rigid core $\tau_{c,r}$ of the Earth) of the Sun (due to the gravitational interactions of the Sun with Jupiter Saturn, Uranus and Neptune) and the planets of the Solar System)

$$\Delta_{g,S,P}(2015) = \frac{\Delta G(\tau_{c,r}, t^*(\tau_{c,r}, 2015)) - \Delta G(\tau_{c,r}, t_*(\tau_{c,r}, 2015))}{\Delta_g E_3(\tau_1, 0, 0, t_1^*(1,3), 0)} = 3842.3175, \quad (144)$$

which is larger than the value (139) for 2011 AD. Taking into account the maximal magnitude $M_{up}(2004)=9.1$ (of earthquakes according to the U.S. Geological Survey) for 2004 AD, the maximal magnitude $M_{up}(2015)=8.3$ (of earthquakes according to the U.S. Geological Survey) for 2015 AD, we evaluate (based on the linear extrapolation) the upper boundary $M_{up}(2020\div2026)$ of the maximal magnitudes $M_{st}(2020\div2026)$ of the strongest earthquakes of the Earth during the range (2020÷2026) AD:

$$M_{up}(2020 \div 2026) = M_{up}(2015) + \frac{M_{up}(2004) - M_{up}(2015)}{\Delta_{g,S,P}(2004) - \Delta_{g,S,P}(2015)}(\Delta_{g,S,P}(2021) - \Delta_{g,S,P}(2015)) = 9.8592. \quad (145)$$

Thus, based on the numerical evaluations (143) and (145), we obtain the range

$$9.1625 = M_l(2020 \div 2026) \le M_{st}(2020 \div 2026) \le M_{up}(2020 \div 2026) = 9.859\ 2 \quad (146)$$

of the maximal magnitudes of the strongest earthquakes of the Earth during the established first forthcoming subrange (2020÷2026) AD [19, 20] of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth.

## 5 Summary of Main Results and Conclusion

We evaluated [19, 20] previously the first forthcoming subrange (2020÷2026) AD (of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth) based on the founded [19, 20] range (105) of the fundamental global seismotectonic, volcanic and climatic periodicities and considering the date (1318 AD [16]) of the great earthquake occurred in England. The novelty of this paper compared to the other references (especially [19] and [20]) is related with the fact that this paper has obtained the rigorous mathematical evidence of the established [19, 20] first forthcoming subrange (2020÷2026) AD (of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth) based on the established [19, 20] rigorously (mathematically) formulated global prediction thermohydrogravidynamic principles (134) and (135) used for the real planetary configurations of the Earth and the planets of the Solar System. Based on the confirmed [21, 23-27] global prediction thermohydrogravidynamic principles (134) and (135) of the cosmic seismology [19, 20], we have presented the logical foundation of the range (146) of the maximal magnitudes of the strongest earthquakes of the Earth during the rigorously (mathematically) founded the first forthcoming subrange (2020÷2026) AD [19, 20] of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth.

We have presented in Section 2 the established [4-6] equivalent generalized differential formulations (10), (17) and (19) (given for the Galilean frame of reference) of the first law of thermodynamics deduced rigorously based on the postulates of the non-equilibrium thermodynamics [37, 38], continuum mechanics [34, 35, 60] and hydrodynamics [36, 61]. The equivalent generalized differential formulations (10), (17) and (19) are valid for moving rotating deforming heat-conducting stratified individual finite one-component continuum region $\tau$ (characterized by the symmetric [34, 35, 38] stress tensor $\mathbf{T}$) subjected to the non-stationary gravitational field. The generalized [5, 6] differential formulation (19) generalizes the classical [9, 33] formulations (1) and (2) by taking into account (along with the classical

[9, 33, 38, 39] infinitesimal change of heat $\delta Q$ and the classical [9, 33, 38, 39] infinitesimal change of the internal thermal energy $dU_\tau \equiv dU$ ) the established [4-6] infinitesimal increment $dK_\tau$ of the macroscopic kinetic energy $K_\tau$ [39, 62], the established [4-6] infinitesimal increment $d\Pi_\tau$ of the gravitational potential energy $\Pi_\tau$, the established [4-6] generalized expression (24) for the infinitesimal work $\delta A_{np,\partial\tau}$ done (during the infinitesimal time interval $dt$ ) by non-potential stress forces acting on the boundary surface $\partial\tau$ of the individual finite continuum region $\tau$, and the established [5, 6] infinitesimal energy gravitational influence (due to the Newtonian non-stationary gravitation) dG (given by the expression (13)) on the continuum region $\tau$ during the infinitesimal time interval dt.

We founded [20] that the generalized differential formulation (19) of the first law of thermodynamics (used for the restrictive conditions $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG=0$) results to the conservation of the total energy $U_\tau+K_\tau+\Pi_\tau=const$ [20, 39] of the individual finite continuum region $\tau$. We founded [63] that the generalized differential formulation (19) of the first law of thermodynamics (used for the restrictive conditions $dU_\tau=0$, $\delta Q=0$ and $dG=0$ related with the adiabatic stationary fluid motion of an ideal fluid) results to the classical Bernoulli integral [61] for the adiabatic stationary fluid motion of an ideal fluid along a considered streamline. We founded [24] that the generalized differential formulation (19) of the first law of thermodynamics (used for the restrictive conditions $dU_\tau=0$, $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG=0$, $dK_\tau\neq0$ and $d\Pi_\tau\neq0$ related with the motion of the planet $\tau$ subjected to the central stationary Newtonian gravitational field) results to the classical Kepler's laws describing the elliptical orbital planetary motion. We founded [24] that the generalized differential formulation (19) of the first law of thermodynamics (used for the restrictive conditions $dU_\tau=0$, $\delta Q=0$, $\delta A_{np,\partial\tau}=0$, $dG\neq0$, $dK_\tau\neq0$ and $d\Pi_\tau\neq0$ related with the motion of the planet $\tau$ and the Sun $\tau_0$ interacting owing to the classical Newtonian non-stationary gravitational field) results to the classical Kepler's laws describing the elliptical orbital planetary and solar motions around the combined mass center of the planet $\tau$ and the Sun $\tau_0$.

We have presented in Section 3 the fundamentals of the thermohydrogravidynamic theory related with the increased intensifications of the global seismotectonic, volcanic and climatic activity of the Earth. We have presented in Section 3.1 the established foundation [19, 20] of the energy gravitational influence of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune) of the Solar System. We have presented in Section 3.1.1 the established [19] evaluations of the relative characteristic maximal positive instantaneous energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets of the Solar System. We have presented in Section 3.1.2 the established [19] evaluations of the maximal positive integral energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets in the first approximation of the circular orbits of the planets of the Solar System. We have presented in Section 3.1.3 the established [18, 19] evidence that the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$ and Saturn $\tau_6$) and the Moon is the predominant cosmic trigger mechanism of earthquakes prepared by the combined integral energy gravitational influence on the Earth of the Sun (owing to the gravitational interactions of the Sun with Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$ and Neptune $\tau_8$), Venus $\tau_2$, Jupiter $\tau_5$, the Moon, Mars $\tau_4$ and Mercury $\tau_1$.

We have presented in Section 3.2 the established [19, 20] catastrophic planetary configurations (of the cosmic geophysics and the cosmic seismology) related with the maximal and minimal combined integral energy gravitational influence on the Earth $\tau_3$ of the Sun $\tau_0$ (owing to the gravitational interactions of the Sun $\tau_0$ with Jupiter $\tau_5$, Saturn $\tau_6$, Uranus $\tau_7$ and Neptune $\tau_8$) and the planets of the Solar System.

We have presented in Section 3.3 the established [19, 20] cosmic energy gravitational genesis of the global seismotectonic, volcanic and climatic activity of the Earth induced by the combined non-stationary cosmic energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun (owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune). We have presented in Section 3.3.1 the established [19] time periodicities of the maximal (instantaneous and integral) energy gravitational influences of the Sun on the Earth owing to the gravitational interaction of the Sun with the outer large planets (Jupiter, Saturn, Uranus and Neptune). We have presented in Section 3.3.2 the established [19, 20] fundamental global time periodicities (related to the combined planetary, lunar and solar non-stationary energy gravitational influences on the Earth) of the Earth's periodic global seismotectonic, volcanic and climatic activity induced by the different combinations of the cosmic non-stationary energy gravitational influences on the Earth of the system Sun-Moon, Venus, Mars, Jupiter and the Sun owing to the gravitational interaction of the Sun with

 

Jupiter, Saturn, Uranus and Neptune.

We have presented in Section 4 the founded confirmation of the thermohydrogravidynamic theory concerning the validity of the previously established [19, 20] first forthcoming subrange (2023±3) AD of the increased global seismotectonic, volcanic, climatic and magnetic activity of the Earth. We have presented in Section 4.1 the established [19] linkage of the greatest earthquake destroyed the ancient Pontus (63 BC [30]) and the great earthquakes [16] occurred in England (1318 AD and 1343 AD), Armenia (1319 AD) and Portugal (1320 AD and 1344 AD). We have presented in Section 4.2 the established [19] linkage of the planetary disasters occurred in the Central Asia (10555 BC [31]) and in the ancient Egyptian Kingdom (10450 BC [32]), and the greatest earthquake destroyed the ancient Pontus (63 BC [30]). We have presented in Section 4.3 the foundation of the established [19, 20] first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic and climatic activity of the Earth. We have presented in Section 4.4 the foundation of the forthcoming dates $t^*(\tau_{c,r}, 2021) = 2021.1$ AD and $t_*(\tau_{c,r}, 2021) = 2021.65$ AD corresponding to the maximal and minimal (respectively) combined planetary and solar integral energy gravitational influences on the internal rigid core of the Earth (and on the Earth as a whole) during the established [19] first forthcoming subrange (2023±3) AD of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth.

Taking into account the combined integral energy gravitational influences of the Sun (owing to the gravitational interaction of the Sun with Jupiter, Saturn, Uranus and Neptune) and the planets (Venus, Jupiter, Mars and Mercury) of the Solar System on the Earth (based on the real planetary configurations of the Earth and the planets of the Solar System) for the considered strongest (since 2004 AD and before 2017 AD according to the U.S. Geological Survey) earthquakes (the strongest 9.1-magnitude earthquake, which struck Indonesia, Northern Sumatra on December 26, 2004; the second strongest 9.0-magnitude earthquake, which struck Japan on March 11, 2011 and the 8.3-magnitude Chilean earthquake, which struck Chile on September 16, 2015 after the first direct detection (on September 14, 2015 [28, 29]) of the gravitational waves and after the calculated (based on the global prediction thermohydrogravidynamic principle (134) used for the real planetary configurations of the Earth and the planets of the Solar System) date $t^*(\tau_{c,r}, 2015) = 2015.6833$ AD (corresponding approximately to September 6, 2015) of the maximal (in 2015) combined planetary and solar integral energy gravitational influence on the internal rigid core of the Earth), we have obtained in Section 4.5 the evaluation of the range $9.16 \le M_{st}(2020 \div 2026) \le 9.85$ (given by (146)) of the maximal magnitudes of the strongest earthquakes of the Earth during the founded (based on the established [19, 20] global prediction thermohydrogravidynamic principles (134) and (135) used for the real planetary configurations of the Earth and the planets of the Solar System) first forthcoming subrange (2020÷2026) AD [19, 20] of the increased intensification of the global seismotectonic, volcanic, climatic and magnetic activity of the Earth.

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