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Secular drift of the center of mass of the Earth and solution of M.V. Lomonosov problem

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"... Has made four newly invented me pendulums... whether to learn always from

the Earth's center attracting heavy bodies, costs motionlessly or varies a place."

From M.V. Lomonosov's correspondence.

By means of the specified devices the measurements continuously since 1756 for 1764 were spent. But as an accuracy did not meet the requirements of put research M.V. Lomonosov has been compelled to ascertain: " oscillations of a gravity are so small, that by the mentioned device could not be noticed " (Kulikovskii, 1986). Two centuries and half it was required on development of the given problem and search of the answer to a question: if secular changes or other variations of a gravity take place in reality, what basic mechanisms of these changes?

The summary. On the basis of geodynamic model of the forced relative displacements of the centers of mass of the core and the mantle of the Earth the variations of a gravity and heights of some gravimetry stations on a surface of the Earth have been studied. At the account of secular drift of the center of mass of the Earth, caused by a secular drift of the Earth's core, the explanation to observable secular variations of a gravity at stations Ny-Alesund (Norway), Medicina (Italy), Churchill (Canada), Syowa (Antarctica), Strastbourg (France), Membach (Belgium) and Wuhan (China) has been done.

The executed research has shown, that the basic contribution to secular variations of a gravity observable by means of absolute and superconducting gravimeters is brought with two factors. First of them is determined by secular drift of the center of mass of the Earth. This factor specified [U+FFFD] [U+FFFD] Lomonosov. The second factor causing gravity variations is a deformation of a surface relatively to the base mantle reference frame. Both these factors give comparative contributions (see tab. 1) and their analysis should be carried out first of all. It is necessary to note also, that additional contributions in secular variations of gravity bring the slow redistributions of masses in the top layers of the Earth (in particular air, oceanic, hydrological and other masses). The specified changes in particular are shown in secular variations of geopotential coefficients. However, they are rather small and in the given work are not considered. Thus we conclude, that secular changes of a gravity are a real phenomenon which is established and is observed on many gravimetry stations of the world. Major factors of the established variations of a gravity are: a secular drift of the Earth's core in northern direction (to it there corresponds the unidirectional drift of the center of mass of the Earth in a direction to Taimyr peninsula) and changes of geodetic heights of stations of observation (they substantially are explained by deformations of a surface of the Earth, caused by a gravitational attraction of the moving core of the Earth). Polar drift of the center of mass of the Earth has been theoretically predicted by the author in 1995 [1] and in a consequence has obtained confirmations in satellite observations by methods of space geodesy. The specified trend of the center of mass basically is explained by accompanying drift of the Earth's core. On our geodynamical studies the secular drift of the center of mass of the core relatively to the center of mass of the mantle in present period is characterized by velocity of 2.6 ± 0.4 cm/yr in a direction to a pole with coordinates 70º N, 105º E (region of Tymyr peninsula) [2] – [7]. The corresponding secular displacement of the center of mass of the Earth will well be coordinated with its drift received by methods of a space geodesy according to system DORIS for the period 1999 - 2008 [5]: velocity of drift of the center of mass of the Earth is estimated in 5.54 mm/yr and directed to a geographical point with coordinates: 72º N, 118º E. The superfluous mass of the core (caused by contrast of average densities of the core and the mantle) is estimated approximately

in 16.7 mass of the Moon. In the given work at the account of secular drift of the center of mass of the core of the Earth, and in view of data about secular changes of GPS heights, the full explanation is given to observable secular variations of a gravity on leading and famous gravimetry stations: Ny-Alesund (Norway), Medicina (Italy), Churchill (Canada), Syowa (Antarctica), Strastbourg (France), Membach (Belgium) and Wuhan (China) (Table 1). For the wide list of gravimetry stations theoretical values of secular variations of a gravity and heights of the stations caused by drift of the core of the Earth (or its center of mass) have been obtained.

According to our preliminary studies similar secular variations of a gravity being contrast relatively to northern and southern hemispheres should be observed on Mars [7].

Table 1. Theoretical and observable values of secular variations of a gravity.

Stations	Core attraction	Surface deformation	Theory	Observations
Ny-Alesund	**+1.60 μGal/yr**	**-(3.77$\pm$0.09) μGal/yr**	**-(2.17$\pm$0.03) μGal/yr**	**-(2.5$\pm$0.9) μGal/yr**
Churchill	**+1.11 μGal/yr**	**-(3.38$\pm$0.28) μGal/yr**	**-(2.22$\pm$0.28) μGal/yr**	**-(2.13$\pm$0.23) μGal/yr**
Medicina	**+1.13 μGal/yr**	**+(1.07$\pm$0.20) μGal/yr**	**+(2.20$\pm$0.20) μGal/yr**	**+(1.90$\pm$0.20) μGal/yr**
Syowa	**-1.44 μGal/yr**	**+(0.63$\pm$0.08) μGal/yr**	**-(0.81$\pm$0.08) μGal/yr**	**-0.56 μGal/yr**
Strastburg	**+1.18 μGal/yr**	**+(0.71$\pm$0.02) μGal/yr**	**+(1.89$\pm$0.02) μGal/yr**	**+(1.90$\pm$0.20) μGal/yr**
Membach	**+1.21 μGal/yr**	**-(1.98$\pm$0.16) μGal/yr**	**-(0.77$\pm$0.16) μGal/yr**	**-(0.6$\pm$0.1) μGal/yr**
Wuhan	**+1.34 μGal/yr**	**-(0.17$\pm$0.05) μGal/yr**	**+(1.17$\pm$0.05) μGal/yr**	**+(1.39$\pm$0.02) μGal/yr**

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