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Solar System Barycentre and Planet's Rotation

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Abstract

Processing of data on the Earth movement (1800-2010) shows, that the planet's rotation depends on the position of Solar System barycentre.

1. Introduction

According to P.D.Jose [1], Solar System barycentre strongly affects the solar activity. The idea of the governing function of the barycentric motion was developed by T. Landscheidt [2, 3], who, above all, had disclosed its role in the Earth atmosphere and ocean. Recently, indubitable evidence of the barycentre and Earth's rotation synchronization have been found.

Scientific methodology requires a comprehensive investigation of fluctuations in the gravitational field intensity during the barycentric motions and their role in planet kinematics. One may use two lines of observations to solve this problem, that is, data on the mean annual and mean diurnal Earth's rotation. Sufficiently robust data on the mean annual rate cover the time period from 1800 to 2009; precise calculations of mean diurnal values are known to be performed since 1962. Below follow the results of these data analysis by the superposed epoch method. Ephemeris are calculated using the EPOS 7 software.

2. Long term data

Naturally, the most sharp rotation perturbations occur during the barycentre motions in the vicinity of extreme trajectory sectors, leading to change in the direction of movement under the influence of giant planets' rotation (Fig. 1).

When the barycentre comes close to the star centre, the Earth's rotation rate naturally increases and then decreases; when the centers move off, we have an opposite picture with the peak rate usually falling to the years of passing the perihelion and the minimum rate during the years of passing the aphelion (Fig. 1).

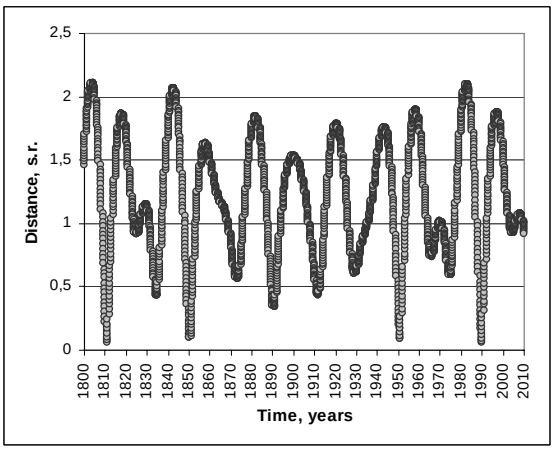

Figure 1. The barycentre movement since 1800, solar radii (s.r.)
Source: calculated basing on the EPOS 7 software

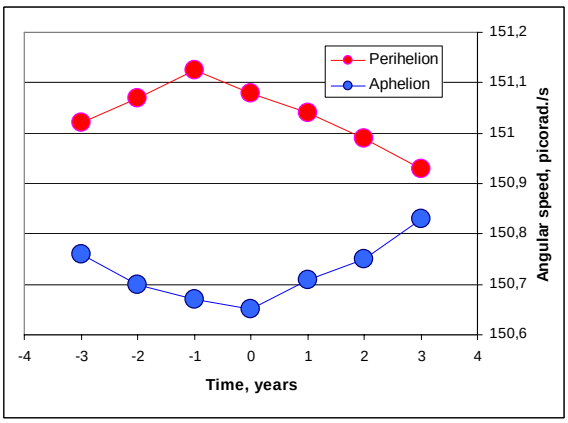

Figure 2. The Earth rotation at the time of the barycentre's perihelion and aphelion passes, angular speed (1800-2010)

Source: calculated basing on the data of International Earth Rotation and Reference Systems Service (http://www.iers.org/IERS/EN/IERS)

3. Short term data

Summarized data on diurnal variations prove the conclusion about accelerated Earth's rotation in the vicinity of the barycentre (at a distance less than 0.55 solar radii; Fig. 2).

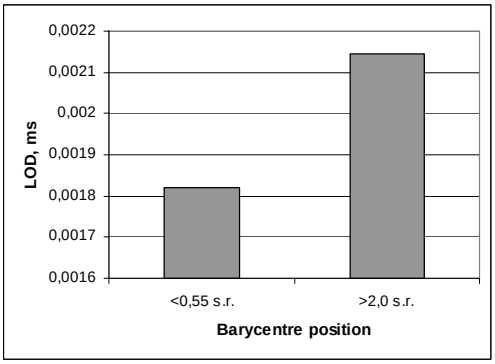

Figure 2. Mean length of day (LOD) at different positions of the barycentre (solar radii), ms
Source: Ibid.

This position is characterized by the least rate deviations from the normal range. In intermediate positions between aphelion and perihelion, planet's rotation rate varies in a very wide range.

4. Forecast

The established patterns give grounds for forecasting. The method of analogies can be applied for the prognosis of the Earth's rotation rate using a known phenomenon of Jose's 179-year periodicity of the barycentric motion (Fig. 3).

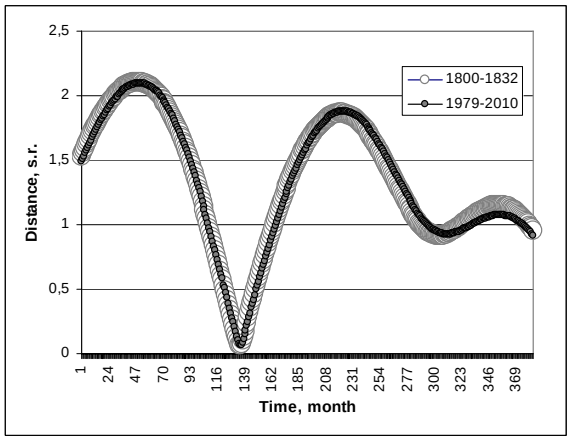

Figure 1. Jose's 179-year periodicity of the barycentric motion
Source: calculated basing on the EPOS 7 software

Consideration of such previous situations, when the barycentre position was close to its future position, will help to define more exactly the terms of future fluctuations. As illustrated in Fig. 5, variations of the Earth's rotation rate were in many respects similar during analogous time periods (correlation coefficient 0.68).

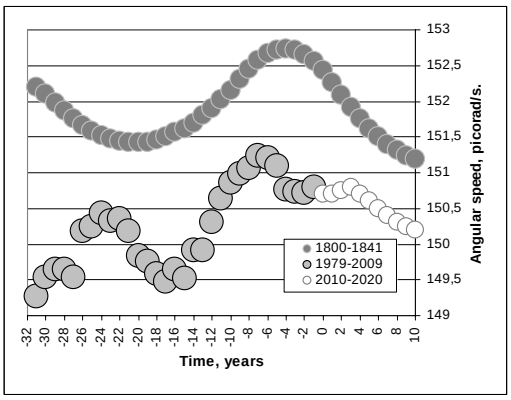

Figure 4. The Earth rotation: past and future
Source: calculated basing on the data of International Earth Rotation and Reference Systems and the EPOS 7 software

The proposed approach results in the following conclusion: the Earth's rotation rate will tend to decrease during the next decade.

5. Conclusions

Large-scale fluctuations of the Earth's rotation rate are determined by the Solar System barycentre motions. Study of these fluctuations is of paramount scientific significance, since it may give further insight on the reasons of geophysical anomalies, such as strong volcanic eruptions, catastrophic earthquakes, climate warming or cooling, etc.

References

[1] Jose P.D. Sun's motion and Sunspots, Astronomical Journal, 1965, 70 (3)
[2] Landscheidt, T. Solar oscillations, sunspot cycles, and climatic change. In: McCormac, B. M., ed.: Weather and climate responses to solar variations. Boulder, Associated University Press, 1983
[3] Landscheidt, T. Forecast of global temperature, El Niño, and cloud coverage by astronomical means. In: Bate, R., ed.: Global Warming. The continuing debate. Cambridge, The European Science and Environment Forum (ESEF), 1998