MAIN RESULTS OF STUDYING THE NATURE OF THE IRREGULARITY OF THE EARTH'S ROTATION

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The variations of the atmospheric angular momentum were investigated (Sidorenkov, 1976). Using the climatic cross-sections of the zonal wind, the values of the relative angular momentum of the atmosphere, h, were calculated for each month. The variations of h during the year are shown in Figure 1, where curve 1 illustrates the sum of h for the entire atmosphere, and curves 2 and 3 illustrate h for the atmospheres of the northern and southern hemispheres respectively.

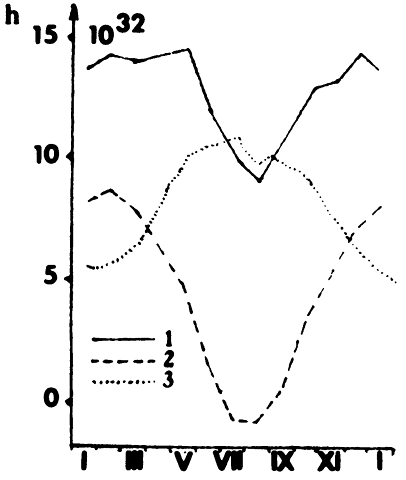

Figure 1. Annual variations in the relative angular momentum of the atmosphere: 1 - the entire atmosphere; 2 - the northern hemisphere; 3 - the southern hemisphere.

From the data on the relative atmospheric angular momentum we can easily derive the corresponding variations in the rate of the Earth's rotation, $\delta\omega/\omega = -\delta h/I\omega$, where ω is the augular velocity of the Earth's rotation, and I is the Earth's moment of inertia. Figure 2 shows both

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the calculated (curve 3) and the observed seasonal variations, $\delta\omega/\omega$ averaged for the period 1956-1961 (curve 2), and for the period 1962-1972 (curve 1). Comparison of the curves confirms the hypothesis that the seasonal irregularity of the Earth's rotation is due to the seasonal variation of h.

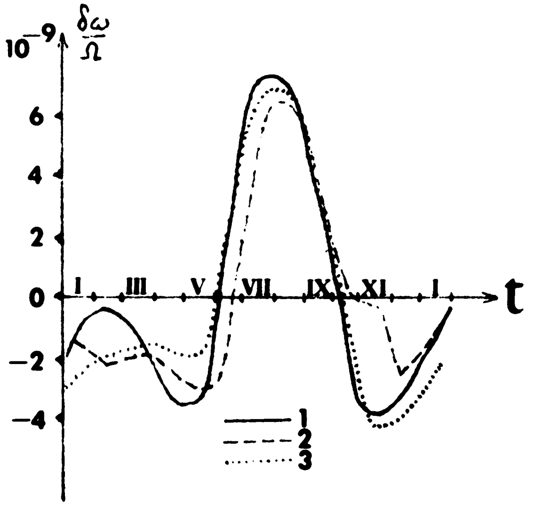

Figure 2. Annual variations in the rate of the Earth's rotation obtained from the data of the atmospheric angular momentum (curve 3), and the astronomical observations averaged for the period 1962-1972 (curve 1), and for 1956-1961 (curve 2).

The correlation of h with the seasonal irregularity of the Earth's rotation yields essential information concerning the atmospheric processes. Studying the nature of seasonal variations, the author discovered a previously unknown thermal engine in the atmosphere - the "inter-hemisphere engine" (Sidorenkov, 1975). This is caused by different seasonal atmospheric heating in the northern and southern hemispheres. As thermodynamic analysis shows, this engine results in the seasonal variation of h and consequently the seasonal irregularity of the Earth's rotation. These seasonal variations are not the sum of annual and semiannual harmonics as had been considered before, but can be written in the form,

$$\frac{\delta\omega}{\omega} = -\frac{\delta h}{I\omega} \sim \left|\Pi + E\cos(\Theta - \beta)\right|,$$

where Π and E are constants, Θ is the "longitude" of the Sun reckoned from the beginning of the year, and β is the phase. For example, the average for the period 1962-1972 of the seasonal irregularity of the Earth's rotation is given as

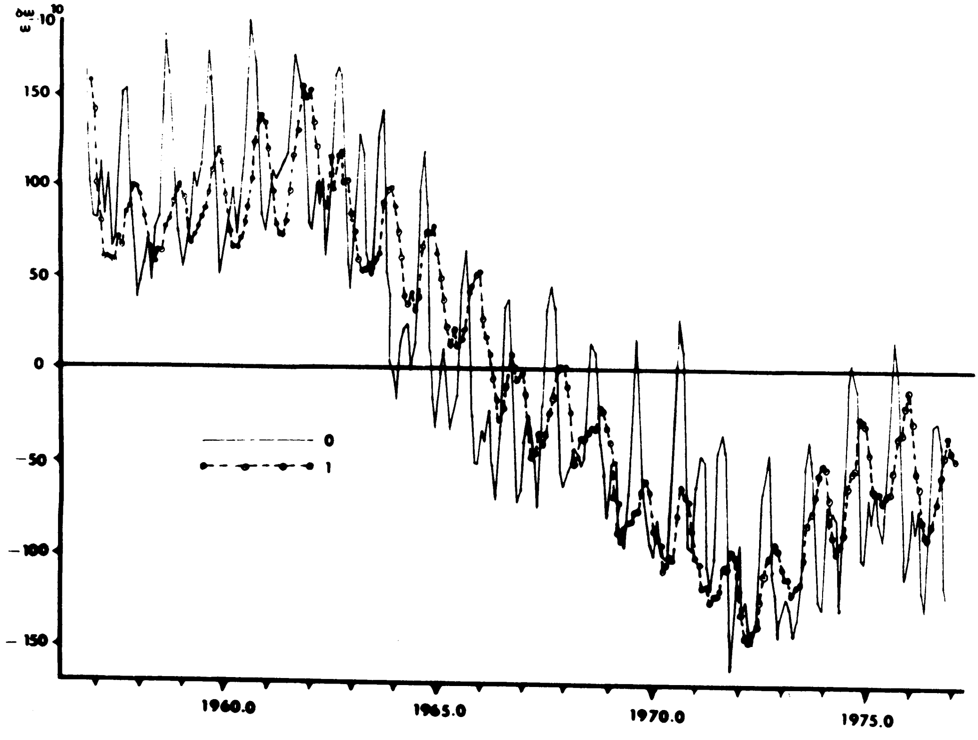

Figure 3. Variations of the mean monthly values of the rate of the Earth's rotation during the recent 20 years: 0 - from the astronomical data; 1 - from theoretical values.

$$\frac{\delta\omega}{\omega} \times 10^{10} = |30 + 89 \cos(\Theta - 201°)|.$$

The inter-hemisphere thermal engine reduces the dominant atmospheric air transport from West to East. Twice a year, in April and November, when the temperature in the northern and southern hemispheres is nearly the same, the effect of the inter-hemisphere engine is absent. Then h is maximum, and the rate of the Earth's rotation consequently is reduced to a minimum. In July and January the opposite effect is observed. Because the temperature difference is more in July than in January h is decreased, and the corresponding increase of the Earth's rotation is greater in July than in January.

The results of the study of the mechanical effect of the atmosphere on the Earth are given by Sidorenkov (1978). The monthly values of atmospheric pressure at ground level for the period 1956.8 - 1977.0 were calculated. These data enabled us to derive the variations of the Earth's rotation due to the friction of the atmosphere on the land surface and its pressure upon mountains. The theoretical curve of the variation of the Earth's rotation as well as the observed irregularity of

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the Earth's rotation are given in Figure 3. Both curves are rather similar with regard to yearly variations. The seasonal variations cannot be obtained in such a manner because the initial assumption in this study was not sufficiently correct.

The above calculations show that the yearly variations of the Earth's rotation are caused by a mechanical atmospheric effect on the Earth. This conclusion causes a problem regarding the balance of the angular momentum of the Earth. In our opinion the Earth-atmosphere system is not closed. It is possible that the flow of small portions of positive or negative angular momentum from space to the atmosphere exists. They cannot be retained in the atmosphere and flow down to the Earth through the near-surface layer. These portions are accumulated by the Earth, and may cause yearly variations in the rate of the Earth's rotation.

REFERENCES

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DISCUSSION

C. R. Wilson: Does this theory imply that the thermodynamic engine causes secular variation of the rotation?
Ya. S. Yatskiv: No. It was not investigated.