ON THE LONG-PERIOD VARIATIONS IN THE RATE OF THE EARTH'S ROTATION

A. I. Emetz and A. A. Korsun'
Main Astronomical Observatory
Ukrainian Academy of Sciences
Kiev, U.S.S.R.

ABSTRACT

The maximum entropy power spectrum (Smylie, et al., 1974) of the Earth's rotational speed was calculated using data from 1900 to 1976. Two series of data were analyzed. The first was a series of $\delta\omega/\omega$ determined from annual UT1 - ET data from 1900 to 1976. The second was a similar series derived from the mean monthly data of UT1 - TAI. Linear trends were removed from both series before analysis. Using the second series of data, significant periods of 2.8, 3.7, 7.0, and 10.5 years were found. The first series showed significant periods at 6, 10, 13, 22, and 57 years. Of these periodicities those at 22 and 57 years showed the largest amplitudes ($0.454 \pm 0.097 \times 10^{-8}$ and $1.431 \pm 0.104 \times 10^{-8}$ respectively).

Various geophysical phenomena such as global motions in the oceans (Naito and Kikuchi, 1973), topographic coupling at the core-mantle boundary (Smith, 1974), variation in the intensity of zonal circulation of the atmosphere (Lambeck and Cazenave, 1974), have been proposed to account for variations in the Earth's rotation with periods from 2 to 10 years. The effect of solar activity may also be a cause of the long-period variations in the Earth's rotation. Afanas'eva, et al. (1965) have shown that the solar wind can interact with the Earth's magnetosphere to induce current within it. A small portion of corpuscular stream energy is sufficient to cause changes in the speed of the Earth's rotation. Afanas'eva (1966a, b) has found a correlation between the 22-year cycle of solar activity and similar variations in the Earth's rotation. Magnetohydrodynamic twisting oscillations in the core of the Earth may account for variations in rotational speed with periods of about 60 years (Braginsky, 1970). While Jady (1969) has shown that solar wind energy is insufficient to explain variations in the Earth's rotation, Kalinin and Kiselev (1977) showed that solar activity may be a cause of such oscillations and that there is a correlation between a 60-year variation in the Wolf numbers and a 60-year variation of $\delta\omega/\omega$.

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The nature of the variation of the Earth's rotational speed occurring with periods of 22 and 60 years needs further study. It is particularly important to construct a quantative theory of the interaction between the solar wind and magnetosphere and, through it, with the mantle which can account for the effect of the interplanetary field. More complete information on the space and time variations of the solar wind are also required.

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DISCUSSION

L. V. Morrison: I wonder how significant the period found at 10 years is? I did not find this in the spectral analysis of my new data.
Ya. S. Yatskiv: The most significant periods are 22 and 57 years.
R. O. Vicente: Analysis of the ILS data extending over 75 years by a maximum entropy method shows a period of about 30 years.