Calculating Insolation of the Earth and Phenomena of the Sun

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Insolation of the Earth

The description of the method for calculating the Earth's insolation is given in the papers [1] - [2]. The program in the MathCad environment for calculating insolation is presented in the Insl2bd.mcd file in Russian and in Insl2bdEn.mcd in English.

Files InsCvSNJ.prn, InsCvWNJ.prn and InsCvTNJ.prn are used in programs for calculating insolation at equivalent latitudes for the summer and winter half-years, and in total value for the year, respectively. The method for calculating insolation in a equivalent latitude for the winter half-year and for the year as a whole is described in paper [3]. The graphs of insolation changes are available in books [4] - [5].

The change in the insolation of the Earth over time, as well as the change in the phenomena of the Sun, as well as the change in a number of other processes and phenomena on the Earth, depends on the evolution of the parameters of the orbital and rotational motions. It is provided in files for different time intervals (from +1 million years to -20 million years) and at different time intervals. The time intervals are reflected in the file names. The file names, time intervals in years (yr), and the number of lines N41 in the data files are as follows:

OrAl1c_8.prn, 0 – 100 yr, N41=2500;
OrAl-5kyr.prn, 0 – -5 kyr, N41=5000;
OrAl-200ky.prn, 0 – -200 kyr, N41=5000;
OrAl0-5My.prn, 0 – -5 Myr, N41=25002;
OrAl-5-10My.prn, -5 – -10 Myr, N41=10001;
OrAl-11-20My.prn, -11 – -20 Myr, N41=20741;
OrAx200kb_4.prn, 0 – 200 kyr, N41=5001;
OrAl_1My.prn, 0 – 1 Myr, N41=5002.

The data in the files contain four columns: 1) time T2, 2) the eccentricity of the Earth's orbit e, 3) the angle of the orbit's perihelion $\varphi_{p\gamma}$, and 4) the angle between the moving planes of the orbit and the equator of the Earth, i.e. obliquity ε.

Time T2 in sidereal centuries of 36525.636042 days per century is counted from the date of 12/30/1949 with a Julian day JD0 = $2.4332805 \cdot 10^6$. The eccentricity of the orbit is determined by the formula

$$e = (R_a - R_p)/(R_a + R_p), \quad (1)$$

where R_a is the orbital aphelion radius, i.e. the greatest distance between the Sun and the Earth;

R_p is the orbital perihelion radius, i.e. the smallest distance between the Sun and the Earth.

The orbital perihelion angle $\varphi_{p\gamma}$ is determined between the position of the perihelion in the orbit and the line of intersection of the orbital and equatorial planes at the starting date December 30, 1949. The angles $\varphi_{p\gamma}$ and ε are given in radians. Graphs of these parameters change are available in books [4] - [6] and in paper [7].

Phenomena of the Sun

The description of methods for calculating the phenomena of the Sun is given in papers [8] - [9], as well as in the book [4]. The program in the MathCad environment for calculating the phenomena of the Sun is presented in the file SunPhnmen.mcd in English. The phenomena of the Sun, as already noted, change in accordance with the change in the parameters of the Earth's orbital and rotational motions.

References

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