THEORETICAL INDICES OF SEASONAL INSOLATION AND ANNUAL HEAT BALANCE IN LATITUDE 40° N DURING EIGHT 12-YEAR SUNTIDE CYCLES

Clyde J. Bollinger

Department of Geography, University of Oklahoma, Norman, Oklahoma

Soli-lunar tides in the atmosphere and oceans, caused by the mutual gravitational interaction of the moon, sun and earth, vary in strength and timing in conformity with the laws of Newton and Kepler, and now are routinely predicted. Since these laws are inherent in the nature of the Solar System and universally applicable, the mutual interaction of the sun and major planets should cause tides in the sun, with strength and timing related to the changing configuration of the major planets. The varying strength of the postulated suntides can be expected to influence the physical processes in the sun which determine the generation and escape of solar energy, and, hence, influence the climates of the planets.

Tide raising forces of planets vary directly with mass and inversely as the cube of distance, or as $\frac{m}{r}^{3}$. When the planets and sun are in alignment their tide raising forces are added. The influence of a planet not in alignment can be computed by multiplying its $\frac{m}{r}^{3}$ by the cosine of its helicentric angle difference. Sidereal periods of the planets are astronomic constants, but differences in the revolution period and orbital eccentricity cause the sun-tide index (SI) to exhibit very complex polycyclic variations.

An index (SI) of the resultant of seven inner planets sun tide was computed at 8-day intervals for the period 1855-1980 from data given in the Annual volumes of the American Ephemeris and Nautical Almanac (1). Assuming a linear relation between SI and solar energy output, indices of earth insolation (GI) were derived by the expression $GI = SI \times \frac{1}{r}^{2} E$ from which monthly insolation values (Q+q) were computed at 5° intervals for 0-80° N. Lat. expressed in percentages of 20.4 k. cal., the normal insolation at the equator in the equinoctial months of March and September (2).

According to Eriksson (3) the annual mean net incoming solar radiation and outgoing radiation as a function of latitude in

TABLE 1. *Theoretical Indices of Clear Sky Zonal Insolation (% of Equinoctial Mo. on Equator).*

(a) Annual Insolation Pattern (I.Q.) Latitude 40°N—Heat Balance Calendar Years 12 Year Period

Year	1	2	3	4	5	6	7	8	9	10	11	12	Mean	Period
1874	75.42	76.35	76.72	77.67	81.61	85.57	86.83	86.36	84.12	80.84	77.92	75.14	80.379	0.1713
1886	75.03	74.06	75.88	79.39	82.89	86.18	87.59	85.23	82.76	79.94	76.16	76.29	80.117	0.0907
1898	74.69	77.00	77.18	80.92	83.14	85.55	85.20	84.28	81.87	79.62	77.13	76.89	80.289	0.0813
1910	76.20	78.33	78.68	81.29	82.84	85.55	84.65	85.09	82.35	79.31	77.14	77.34	80.731	0.5233
1922	77.11	75.20	77.98	80.55	82.40	84.76	85.50	85.07	82.31	79.55	77.30	76.53	80.355	0.1473
1934	75.34	75.59	77.64	80.59	84.23	86.63	87.22	84.76	81.47	79.13	77.18	75.46	80.437	0.2293
1946	75.00	75.17	79.07	81.38	84.56	86.75	84.93	81.85	80.89	76.19	72.37	75.09	79.351	0.8567
1958	75.96	76.80	79.65	82.09	83.24	85.24	82.84	84.08	80.61	77.77	74.98	75.74	80.003	0.2047
Mean	75.84	76.06	68.37	80.485	83.11	85.78	85.595	84.59	82.048	79.04	76.27	76.06	80.2077	

(b) Seasonal 12 Year Cycle Means (I. + q.) Latitude 40°N

Period	Winter	Spring	Summer	Fall	All Seasons Annual	Mean Annual Heat Balance Dev.
1874-85	45.620	99.205	110.441	67.498	80.053	+0.607
1886-97	40.766	98.286	110.504	67.542	80.718	−0.982
1898-09	45.908	97.604	110.503	67.361	79.229	−0.226
1910-21	46.119	98.551	110.320	66.109	79.985	+0.738
1922-33	46.663	97.914	111.546	67.582	80.949	+0.265
1934-45	45.625	98.258	110.452	66.874	80.476	+0.221
1946-57	44.293	97.438	110.916	66.929	80.432	−0.623
Mean	44.999	98.1794	110.344	66.678	79.688	
1958-69	45.47	96.802	110.665	67.0107	80.211	

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the northern hemisphere balance is about 40° north latitude, with an excess in 0-40°N. and a deficit in 40-90°N. in the earth's annual heat balance. Theoretical seasonal insolation (Q+q) values for latitude 40°N. are given in Table 1.

The 12-year, 59-60 year, and 83-84 year tidal recurrences are powerful, and should be reflected in climatic records, along with the lunar Cycle investigated (4). The rotation of the sun and the declination of the planets relative to the Solar equator have been neglected as factors in cyclical astro-climatic phenomena.

The postulated lineal relation between the strength of sun tides, solar radiation, global insolation and cyclic climate variation needs to be tested by sattelites' measurement of insolation and earth albedo outside of the atmosphere and (Q+q) values determined for the southern hemisphere. Basic astronomical ephemeris data are complete and readily available in many libraries. Solar, global and zonal northern hemisphere insolation indices have been computed at 5° latitude intervals and 8-day or 10-day intervals for the period 1855-1980. Monthly tables for convenient application to climatic records are available (5, 6). Basic astronomic data for the period 1900-1980 have been transferred to magnetic reel tape and now are available to investigators.

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