Influence of Planetary Configuration on Sunspots and Winter Temperature at Winnipeg and St. Louis

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The sun is a variable star (1) whose surface is characterized by cyclically recurring variations in sunspot activity accompanied by variations in energy output to which world weather phenomena are known to be related (2,3). The objective of this paper is to present data in support of the hypothesis that changing configuration of the planets, through their tidal action on the sun produce cyclic variations in December and January temperatures at Winnipeg and St. Louis, and presumably elsewhere on the earth.

The possibility of sun-tides, induced by the gravitational attractions of the planets was argued by Schuster (7), and discussed favorably by Stetson (8). Such tidal activity might be expected to influence both sun-spot activity and the output of solar energy and hence weather and climate on the earth. Above normal radiation on or near the winter solstice would have greatest influence at the earth's surface in low southern latitudes where insolation is relatively direct and days are long, but could also cause above normal warming of the upper atmosphere near the Arctic Circle where the rays are tangent and hence largely absorbed by the upper atmosphere, and thereby, in a measure, counteract the dominant radiational cooling process of the winter season. Relatively strong sun-tides, analogous to spring tides might be expected to give rise to above normal radiation and to relatively mild January temperatures at such high latitude continental interior stations as Winnipeg and St. Louis. January mean temperatures at Winnipeg are available for the 78 year period 1875-1952, and at St. Louis for the 116 year period 1837-1952.

The sun-tide raising force of any planet varies directly with its mass and inversely as the cube of its distance from the sun. Four planets. Jupiter, Venus, Mercury, and Earth with the following relative tide-force values at mean distance, it appears, must dominate the sun-tide system:

PLANET	$\frac{M}{r^3}$
Jupiter	2.17
Venus	2.10
Mercury	1.10
Earth	1.00

It will be noted that the tide raising force of the nearly circular orbit planet Venus is almost as great as that of the rather eccentric Jupiter, and that mean distance tide-force of Earth, a planet of considerable eccentricity is nearly as great as that of the extremely eccentric planet Mercury.

Since the tide-raising force of any pair of planets attains a maximum, neglecting eccentricity and declination, when they are in conjunction or opposition and minimum when 90 heliocentric degrees apart, or in quadrature, it is evident that their phase recurrence period will be equal to one-half their mean synodic period. When in conjunction or opposition the mean tide force of Jupiter and Venus is 4.17 (or 2.17 + 2.10) but when in quadrature their combined tidal effect is 0.07 (or 2.17 — 2.10) Hence if, for simplification, the Jupiter wave is considered constant and each of the other planets is considered with respect to its influence on the Jupiter wave an expression of the principal sun-tide variations may be computed by the following expression:

$$T_s = 2.10 \cos (l_V - l_J) + 1.1 \cos (l_M - l_J) + 1.0 \cos (l_E - l_J)$$

Where l is the heliocentric longitude of the planet and J, V, M, E identify the respective planets.

It is evident that with a tide force of 2.10 Venus should have the strongest influence on the Jupiter wave and hence by hypothesis on the output of solar energy and the weather. One half of the Jupiter-Venus mean synodic period is 0.324431 years or 118.5 days and annual phase recurrence, since three of these hemicyclic periods is 0.973293 years, will be .026707 years or 9.75473 days earlier on successive years. Mercury with a mean tide force of 1.1 has with Jupiter a half synodic period of 0.12292075 years or 44.8968 days, and eight of these hemicyclic periods is 0.983366 years. Hence corresponding tidal phases of Mercury relative to Jupiter will, if the very high eccentricity of Mercury's orbit is neglected, occur 6.0755685 days earlier on successive years. One half of the mean synodic period of Earth and Jupiter is 0.5460549 years and one synod is 1.0921098 years. Hence, corresponding tide phases will recurr .0921098 years or 33.6431 days later on successive years. However 5.5 Earth-Jupiter synods equals 6.0066039 years resulting in phase recurrence on the sixth year only 2.412 days later.

The mean length of the sun-spot period, as given by Stetson (8) is 11.2 years. The precise length, it appears from the tidal relations of the planets should be 11.199525 years in which period the planets, neglecting orbital eccentricities, complete revolutions as follows:

Mercury	46.50
Earth	11.1199077
Venus	18.20439
Jupiter	0.9744133

In five of these cycles or 55.997625 years the number of revolutions is as follows:

Mercury	232.50
Earth	55.995385
Venus	91.02196
Jupiter	4.7206659

In the above period Earth and Venus return approximately to their original positions and Mercury advances 180° and hence is in alignment

TABLE I

Relation of Planetary Suntide Indices to December-January Temperatures at St. Louis and Winnipeg.

DATE	SUNTIDE INDICES			SUNTIDE RESULTANT WITH SIGN OF DEPARTURE	MEAN DEC.-JAN. TEMP. IN DEGREES F. WITH SIGNS OF DEPARTURE	
JAN. 3	2.11 TIMES COS V/J VENUS	1.0 TIMES COS E/J EARTH	1.1 TIMES COS M/J MERCURY		ST. LOUIS	WINNIPEG
1838	.18755	.5150	.68178	1.38438—		
39	.35555	.01047	.26422	.63024—	32.3—	
1840	.87501	.4970	.19855	1.57056—	28.3—	
41	1.33647	.86690	.62777	2.83114+	32.3—	
42	1.71142	1.0000	.94391	3.65533+	38.4+	
43	1.96989	.85810	1,09296	3.92095+	35.9+	
44	2.09776	.48180	1,04731	3.62687+	35.4+	
45	2.08636	.02792	.81488	2.92916+	38.6+	
46	1.93655	.52840	.43153	2.89648+	33.1—	
47	1.65824	.88540	.15499	2.69863+	33.5+	
48	1.26684	.99890	.47014	2.73588+	32.1—	
49	.66950	.83870	.82390	2.33210—	31.0—	
1850	.26809	.47780	1.0543	1.80319—	33.4—	
51	.27541	.06627	1.08845	1.43013—	33.4—	
52	.80074	.56060	.92565	2.28699—	29.8—	
53	1.66268	.90260	.59741	3.16269+	35.2+	
54	1.93930	.99650	.16449	3.10029+	31.3—	
55	1.93930	.81310	.29953	3.05193+	35.3+	
56	2.08742	.41310	.70851	3.20903+	26.4—	
57	2.09712	.10279	.99286	3.19277+	24.5—	
58	1.98150	.5195	1.09978	3.60078+	40.5+	
59	1.70488	.9184	1.01409	3.63739+	35.9+	
1860	1.33077	.9925	.74173	3.06500+	29.4—	
61	.87826	.7944	.34177	2.00443—	31.1—	
62	.35188	.3778	.11880	.84848—	34.6+	
63	.19490	.1409	.55990	.89570—	39.4+	
64	.72520	.6225	.90112	2.24882—	32.1—	
65	1.21029	.9323	1.08119	3.22378+	28.8—	
66	1.71718	.9871	1.06865	3.66736+	31.5—	
67	1.90596	.7705	.86550	3.54196+	29.5—	
68	2.07391	.3437	.50963	2.92724+	30.6—	
69	2.10430	.17880	.06140	2.34450—	32.5—	
1870	1.92305	.6639	.39600	2.98295+	32.0—	
71	1.75130	.9455	.78463	3.48143+	32.0—	
72	1.39260	.9803	1.03301	3.40591+	28.2—	
73	.94148	.7466	1.09703	2.78511+	23.5—	
74	.42790	.3074	.9658	1.70110—	30.7—	
75	.14108	.2164	.6952	1.05268—	30.6—	—6.55
76	.65199	.6794	.24178	1.57317—	42.3+	—0.95
77	1.14298	.9473	.22121	2.32149—	28.0—	—7.35
78	1.55823	.9722	.64812	3.17855+	42.1+	17.20
79	1.86988	.7206	.94776	3.53824+	27.3—	2.25
1880	2.05746	.2706	1.09527	3.42333+	40.9+	—7.55
81	2.10873	.2521	1.03939	3.40022+	25.2—	—6.30
82	2.01884	.7071	.79926	3.52520+	37.6+	3.8
83	1.79518	.9677	.41558	3.17846+	32.7—	—6.0
84	1.47889	.9627	.04030	2.48193—	33.5+	—5.8
85	1.01322	.6934	.49082	2.19744—	30.0—	—8.1
86	.43149	.2334	.85360	1.51849—	32.3—	—4.05
87	.03314	.2890	1.06348	1.38562—	30.5—	—9.6
88	.57455	.7337	1.0846	2.39285—	28.5—	—8.0
89	1.07399	.9759	.9130	2.96289+	26.5—	8.7

TABLE I (Continued)

Relation of Planetary Suntide Indices to December-January Temperatures at St. Louis and Winnipeg.

DATE	SUNTIDE INDICES			SUNTIDE RESULTANT WITH SIGN OF DEPARTURE	MEAN DEC.-JAN. TEMP. IN DEGREES F. WITH SIGNS OF DEPARTURE	
JAN. 3	2.11 TIMES COS V/J VENUS	1.0 TIMES COS E/J EARTH	1.1 TIMES COS M/J MERCURY		ST. LOUIS	WINNIPEG
1890	1.50232	.95160	.57805	3.03197+	44.5+	—2.45
91	1.83105	.6652	.14168	2.63793—	37.1+	9.55
92	2.03805	.1891	.32164	2.54878—	34.5+	2.40
93	2.1100	.3502	.72743	3.18763+	28.9—	—5.95
94	2.04100	.7593	1.00254	3.80284+	39.9+	—7.55
95	1.83654	.98390	1.10	3.91964+	32.5—	2.4
96	1.51012	.9391	1.10018	3.45099+	36.0+	1.25
97	1.08348	.6374	.71005	2.43093—	35.7+	4.4
98	.58509	.16160	.31977	1.06664—	35.0+	7.57
99	.04418	.3600	.14358	0.54776—	32.6—	— .55
1900	.49606	.7826	.58124	1.85990—	35.2+	7.45
01	1.00351	.9900	.92675	2.92026+	37.6+	2.5
02	1.44429	.9252	1.08516	3.45475+	31.3—	6.3
03	1.78928	.6074	1.07304	3.45972+	33.9+	2.75
04	2.01568	.12187	.83765	2.97520+	28.8—	— .80
05	2.10831	.39710	.48741	2.99286+	29.5—	— .60
06	2.06147	.8059	.03839	2.90596+	36.1+	8.95
07	1.87494	.99470	.41921	3.28174+	36.4+	—5.0
08	1.56562	.9278	.80058	3.29498+	36.0+	9.95
09	1.15227	.5764	1.04071	2.78638+	35.8+	3.3
1910	.65895	.08368	1.09516	1.83779—	29.5—	3.2
11	.12514	.43050	.95458	1.51024—	33.8+	—2.8
12	.41714	.8281	.6435	1.88874—	29.4—	0
13	.93156	.9979	.21934	2.14870—	36.7+	2.95
14	1.38437	.8942	.24563	2.52420—	40.4+	12.7
15	1.74518	.5446	.66506	2.95484+	29.1—	0.45
16	1.99141	.34530	.96756	3.30427+	34.8+	1.8
17	2.10345	.46480	1.09714	3.66539+	34.2+	—3.75
18	2.07602	.8490	1.03169	3.95672+	22.8—	—4.05
19	1.91081	.9996	.78188	3.69229+	30.4—	12.15
1920	1.64200	.8763	.39424	2.91254+	29.0—	3.05
21	1.21936	.5120	.04606	1.77743—	38.3+	8.9
22	.69563	.00873	.51128	1.21564—	34.4+	6.3
23	.20589	.4985	.86801	1.57340—	38.1+	3.05
24	.33734	.8678	1.0692	2.27435—	35.5+	7.15
25	.85476	.9999	1.08053	2.93519+	31.5—	— .5
26	1.32216	.8572	.89881	3.07817+	33.7+	8.65
27	1.70044	.4802	.55825	2.73889+	32.5—	3.4
28	1.96863	.02967	.01677	2.01507—	33.5+	3.0
29	2.09565	.5314	.34353	2.97058+	33.1—	4.2
1930	2.08404	.8878	.74459	3.71641+	31.1—	—1.1
31	1.94373	.9988	1.01178	3.95431+	36.8+	12.6
32	1.64432	.8377	1.09067	3.58169+	42.5+	12.4
33	1.28161	.4462	.99121	2.71902+	38.9+	2.55
34	.80981	.06627	.81708	1.69316—	39.0+	.6
35	.28636	.5621	.16638	1.01485—	33.7+	—1.3
36	.25714	.9033	.16828	1.32875—	27.8—	—2.9
37	.78365	.9962	.92774	2.70759+	35.0+	—1.65
38	1.25777	.8161	1.08878	3.16265+	32.7—	2.5
39	1.65128	.4115	.98980	3.05258+	38.4+	7.45

TABLE I (Continued)

Relation of Planetary Suntide Indices to December-January Temperatures at St. Louis and Winnipeg.

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JAN. 3	2.11 TIMES COS V/J VENUS	1.0 TIMES COS E/J EARTH	1.1 TIMES COS M/J MERCURY		ST. LOUIS	WINNIPEG
1940	1.93212	.06453	1.05633	3.05298+	28.3—	14.15
41	2.08468	.59340	.83644	3.51448+	37.7+	8.2
42	2.09881	.9191	.46662	3.48453+	36.9+	12.35
43	1.97369	.9923	.01535	3.11955+	32.7—	—3.6
44	1.70910	.7934	.44033	2.94283+	35.1+	13.15
45	1.34491	.3762	.81741	2.53852—	29.0—	6.95
46	.88545	.14263	1.04797	2.07605—	31.6—	2.0
47	.36629	.6239	1.09252	2.08271—	39.2+	6.3
48	.17656	.9330	.94292	2.05248—	32.7—	1.95
49	.70790	.9869	.62458	2.31938—	34.0+	2.15
1950	1.19510	.7694	.19668	2.16118—	39.7+	—5.7
51	1.59959	.3649	.26818	2.23267—	31.3—	— .5
52	1.89814	.1805	.68475	2.76340+	36.0+	0.9
			Means	2.6496	33.42	

though if originally in perihelion it will, at the end of the period, be in aphelion. Jupiter in this period will have advanced .7 of a revolution and be .3 of a revolution out of phase or only 18° from quadrature with the Earth-Venus-Mercury alignment. A relatively weak tidal configuration results since the strongest planet, Jupiter, only 18° from quadrature, can largely neutralize the tide force of the other three planets, now weakened by Mercury being in aphelion. Thus, secular trends in strength of sun-tide phases sunspots and climate in 56 year hemicycles of a long 111.19077 year ten-cycle astronomical sun-tide cycle is indicated.

Since siderial periods of the planets are astronomical constants, mean synodic periods are also constants and if orbital eccentricity is neglected positions and angular differences for any date are easily calculated.

The siderial periods, and positions of Jupiter, Venus, and Mercury on earth's perihilion January 3, 1954, as given in the American Ephemiois and Nautical Almanac for 1954 are as follows:

	SIDERICAL PERIOD IN TROPICAL YEARS	LONG. JAN. 3, 1954		
Jupiter	11.86223	83°	0.08′	53.77″
Venus	0.61521	266°	52′	22.2″
Mercury	0.24085	260°	19′	58.6″
Earth	1.00004	101°	0	14.1

Starting with the above reference positions and rates of movements, circular orbit positions on each January 3 were computed back to 1838 and variations in the strength of the Jupiter sun-tide as influenced by Venus, Earth, and Mercury were calculated, according to the above expression.

The successive January 3, positions of Jupiter expressed in decimals of revolution from heliocentric zero are given in Table I along with three planet indices, and average December and January temperatures at St. Louis and Winnipeg.

It should be remembered that the indices in Table I are only crude samplings of true mean January and February sun-tide values since:

1. They are for a single date.
2. Orbital eccentricities and declinations are neglected.
3. Tidal influences of Mars, Saturn, Uranus, and Neptune are also neglected.

It will be noted that weak January 3 sun-tides were accompanied by below normal temperatures at Winnipeg in 1875, 1876, and 1877 and by below normal temperatures at St. Louis except in 1876. The exceptional mildness of 1878 and 1879, and 1882, both at Winnipeg and St. Louis, occurred on years of high sun-tides. In the five year period of weak January 3 sun-tides, 1884-1888, winters were relatively cold each year at Winnipeg and on all except two of the years (1884 and 1886) at St. Louis. However, a normal index in 1891 was accompanied by mild weather both at Winnipeg and St. Louis.

In the earlier records for St. Louis there is good agreement between temperature and sun-tides in the periods of high index values from 1840-1848 and 1850-1859. The high index years 1907 and 1908 were associated with mild weather at St. Louis and at Winnipeg in 1908. The low index years, 1910-13, were accompanied by below normal temperatures at Winnipeg, as also were the low index years 1933-1947.

These instances of correlation provide evidence that changing planetary configuration, through their tidal influence on the sun, control variations in weather and climate on the earth. A more accurate and complete array of sun-tide values are required before the hypothesis can be adequately tested.

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