FIGURES

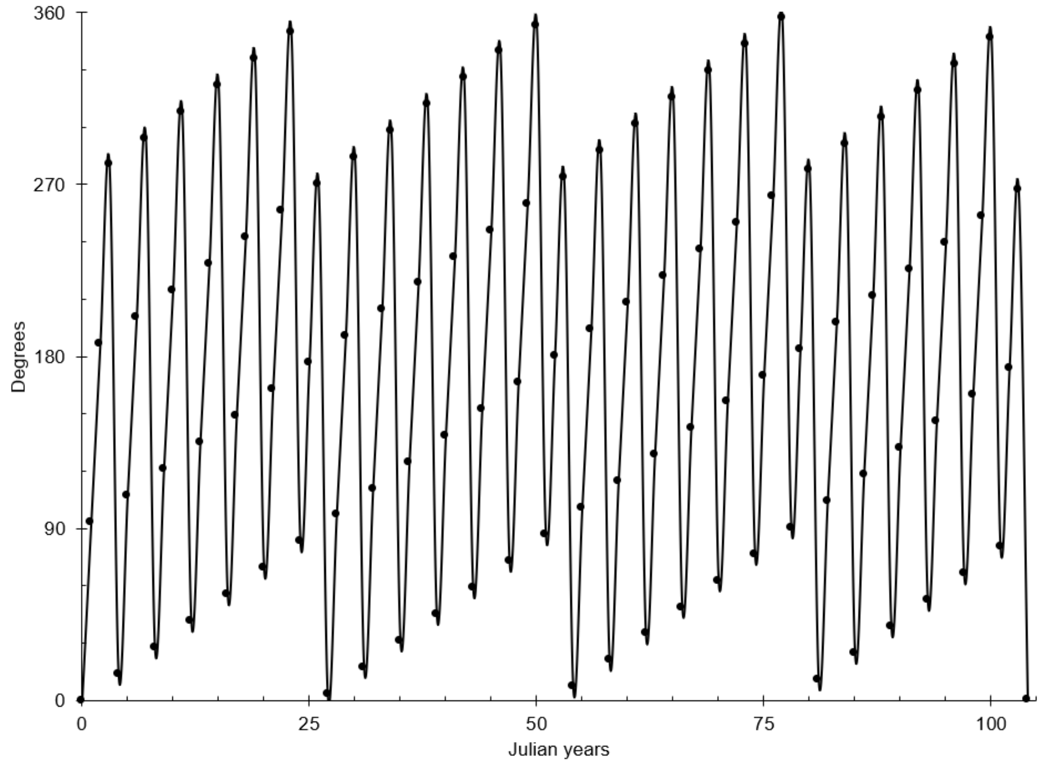

Figure S1: Earth's spin-orbit coupling relative to the perihelion (anomalistic year cycle). The first closest return (<1º) to the starting point occurs at 104 yrs. Two other close returns can be seen at 27 yrs (3.66º) and 77 yrs (-2.89º); The third return at 54 yrs is -7.32º).

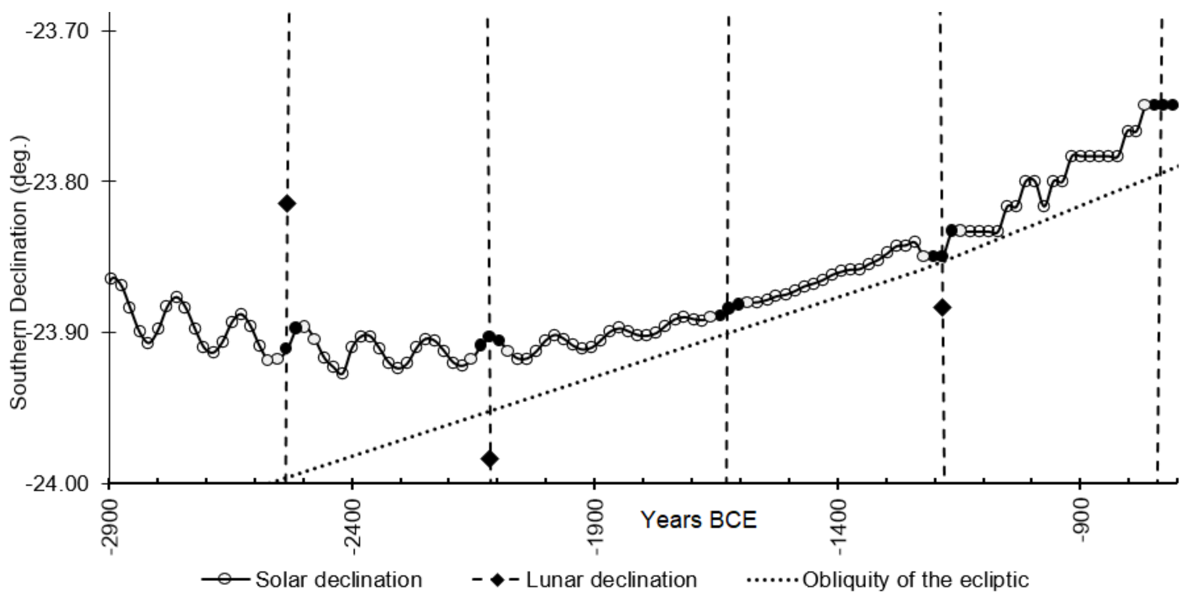

Figure S2: Zoom of solar declinations associated with the Metonic lunation series based on the current perihelion, showing the flattened declinations between ~1900 BCE and ~700 BCE. Black-filled markers are total or annular eclipses; grey-filled markers are partial solar eclipses. The dotted line shows the obliquity of the ecliptic. A Metonic eclipse occurs right on the ecliptic at the December solstice in 1183 BCE.

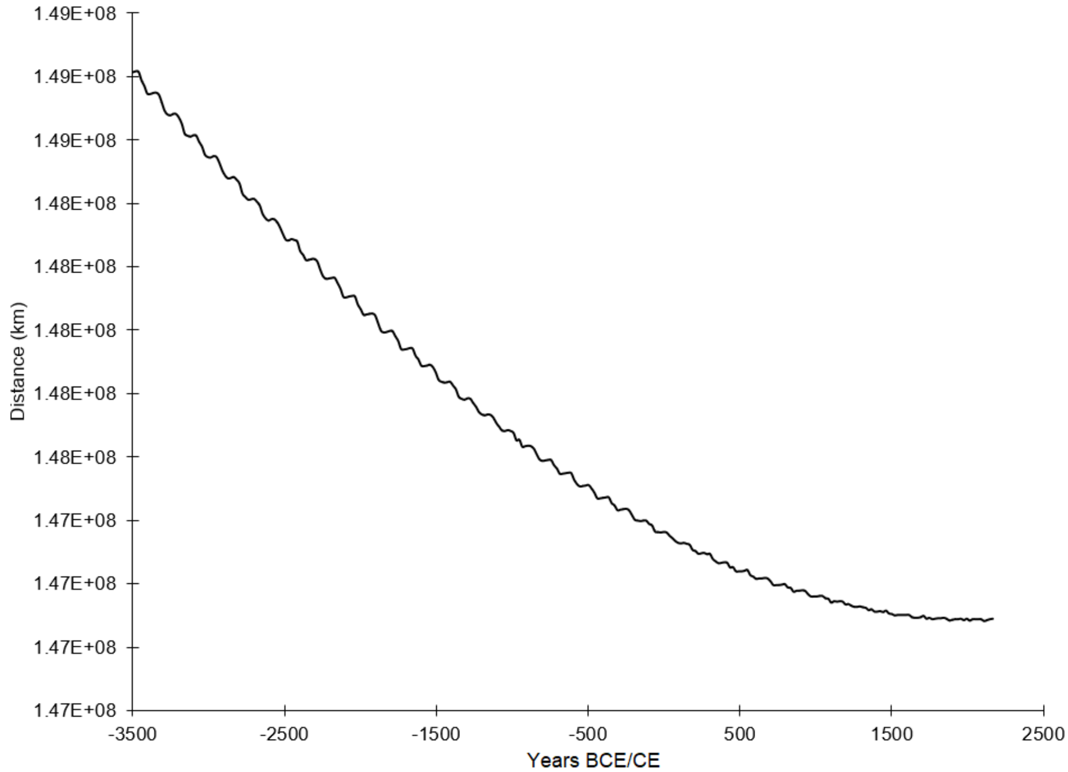

Figure S3: Earth-Sun distance at Metonic lunation (based on Metonic lunation series associated with the current perihelion). Negative values on the x-axis are BCE. The wiggles are 133-yr intervals and rarely at 114-yrs.

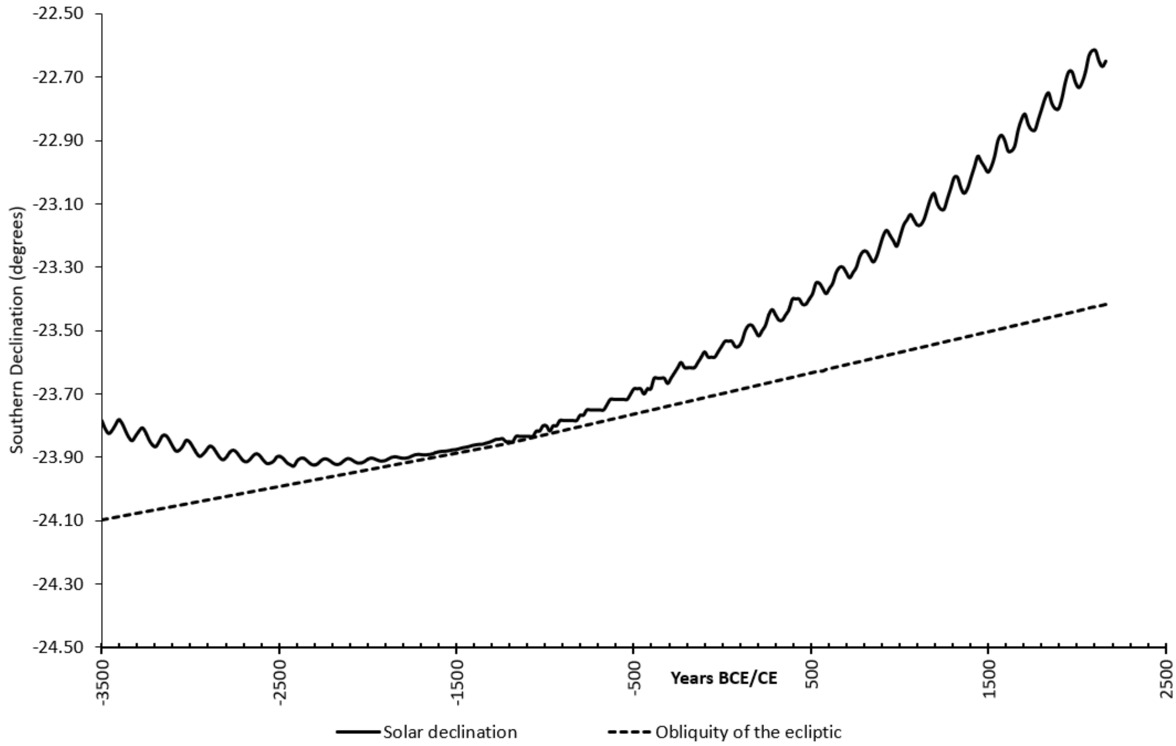

Figure S4: Solar declination changes relative to the obliquity of the ecliptic over the past 5.5 ky. The 1000-yr period during the 2nd millennium BCE was a time of suppressed solar declination variation. Negative values on x-axis are BCE. Peaks occur at 133-yr intervals.

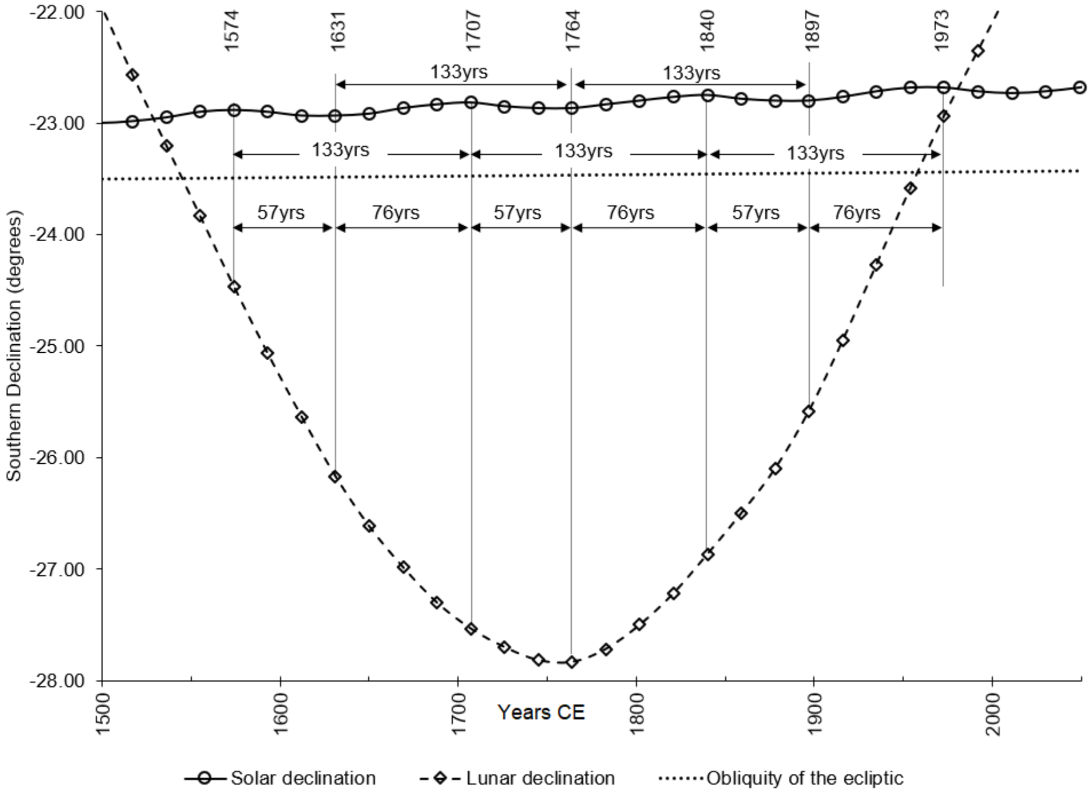

Figure S*5*: Solar declination cycle since 1500 CE shows a periodicity spanning 133 yrs, comprised of 57-yr and 76-yr sub-periods.

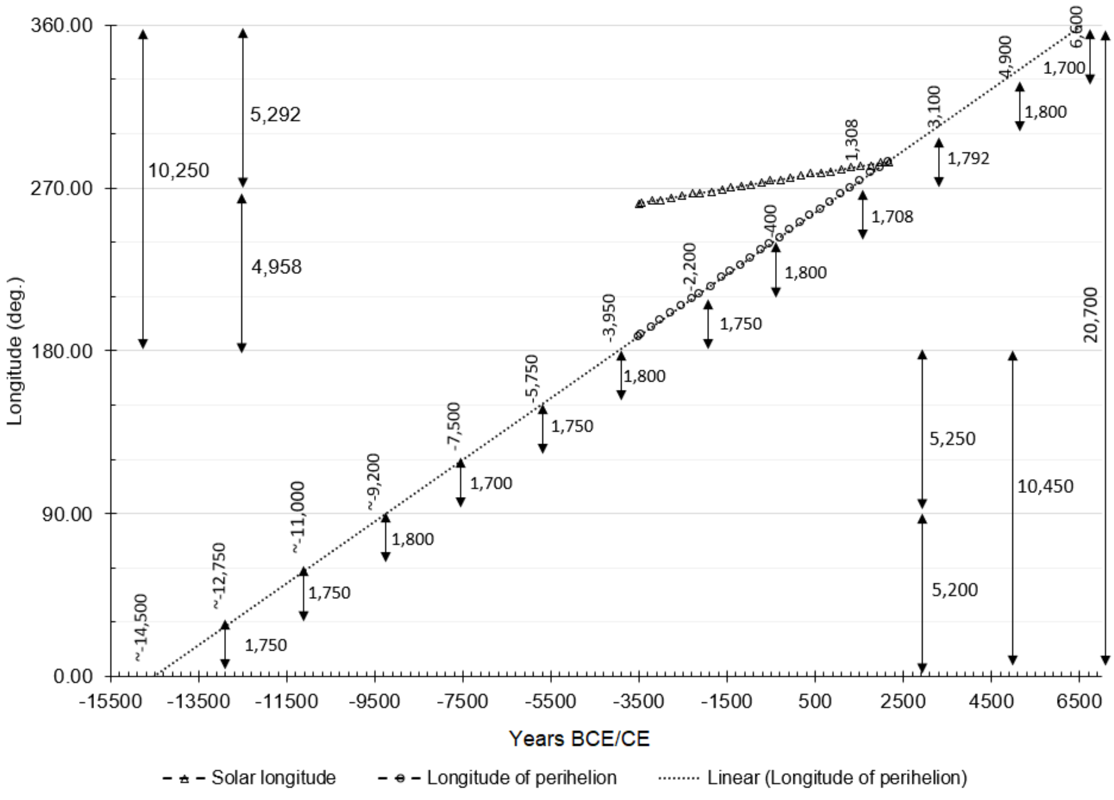

Figure S6: Movement of the perihelion through the tropical year. A cycle of ~21 ky can be seen, with quarterly cycles in the vicinity of the length of Heinrich IRD events. Solar and lunar gravitational forcing respectively contribute one-third and two-thirds to precession (Lowrie, 2004).

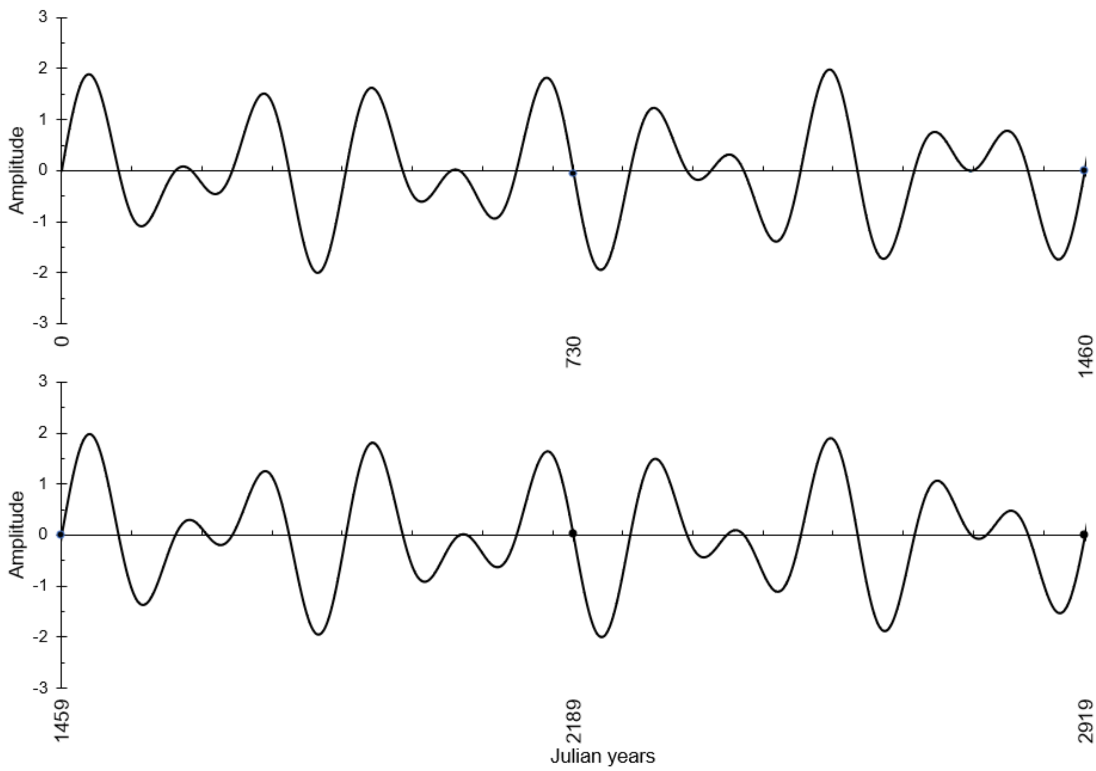

Figure S7: The modelled superposition of the 133-yr and 207.54-yr cycles. The interaction produces a cyclical pattern that repeats after 1459 Julian years. This can be seen in the strongly similar patterns between the first 1459 yrs (top panel) and second 1459 yrs (bottom panel).

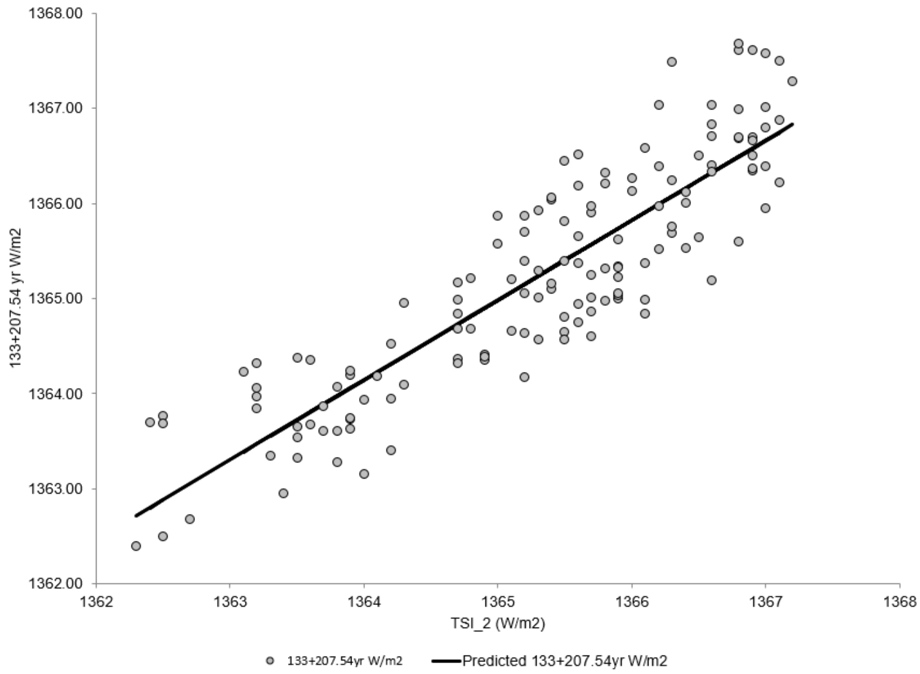

Figure S8: Regression Line-Point Fit between the model (expected behaviour) and TSI_2, which is the total solar irradiance reconstruction by Bard et al.(Bard et al., 2007) with geomagnetic corrections based on ^{10}Be isotopes from the South Pole. A strong positive correlation is shown. This regression line fit is very similar to those of TSI_1 and TSI_3.

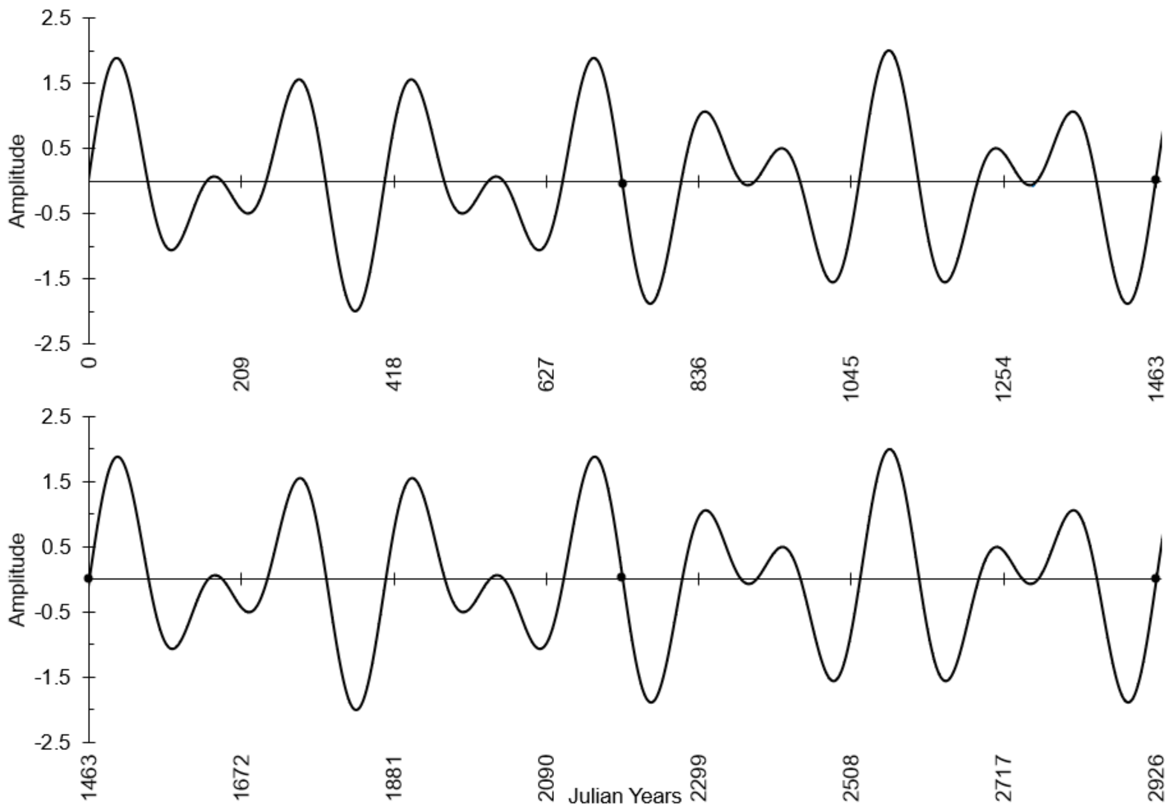

Figure S9: Modelled activity of the interaction between the 209-yr and 133-yr cycles at 19-yr resolution. The cycle repeats itself every 1463 Julian years. This can be seen in the strongly similar patterns between the first 1463 yrs (top panel) and second 1463 yrs (bottom panel).

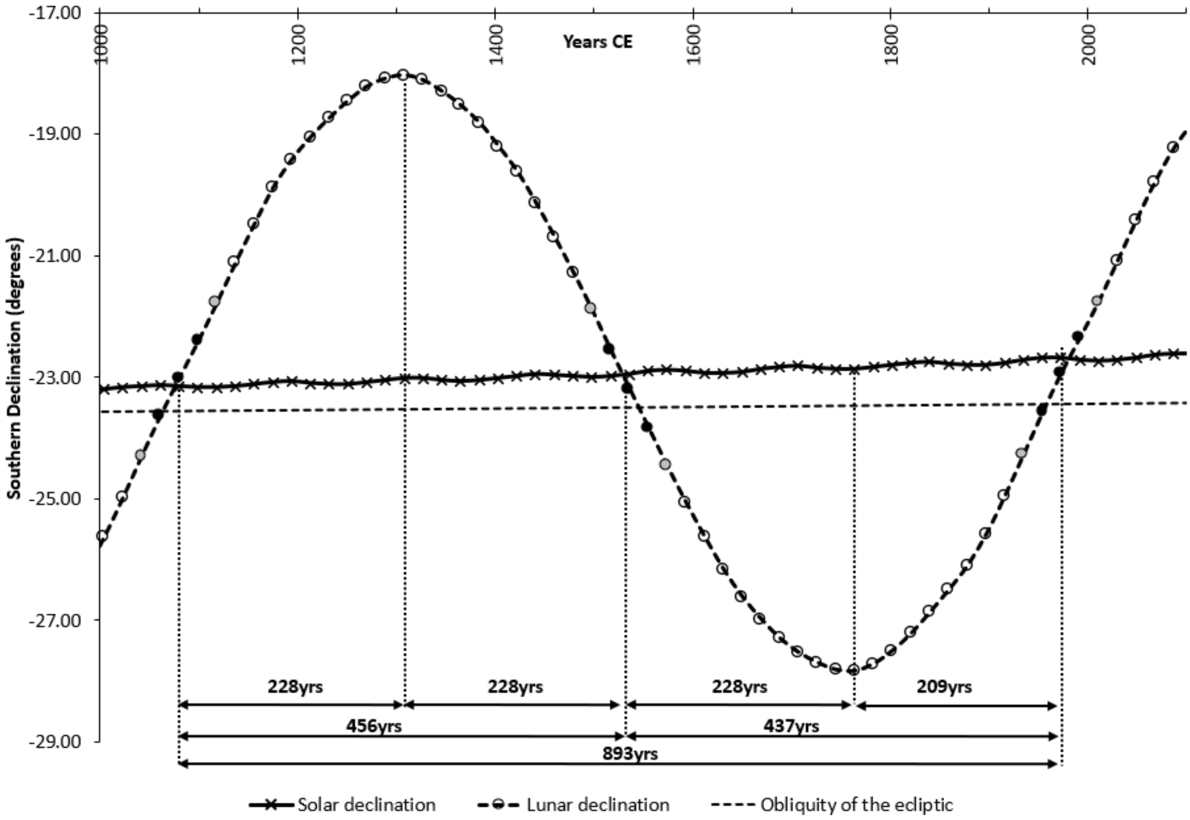

Figure S10: Lunar declinations since 1000 CE showing one periodicity of a Metonic lunation series of 893 yrs, composed of four phases (three 228-yr periods and one 209-yr period). Black-filled markers are total or annular solar eclipses; grey-filled markers are partial solar eclipses.

TABLES:

Table S1: Daily approximation of TSI values (W/m2) and daily rate of change (TSI Var) during 1992 (January to March inclusive). Calculations for TSU values are based on the Julian Day (JD) and associated sine value, where (i) y=sin(2π x ((JD-277)/366)), and (ii) TSI =1361+(y*46.9).

Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2
1-Jan-92	0	0.9991	1407.86		1-Feb-92	31	0.8827	1402.40	-0.37	1-Mar-92	60	0.5511	1386.85	-0.67
2-Jan-92	1	0.9997	1407.88	0.03	2-Feb-92	32	0.8745	1402.01	-0.38	2-Mar-92	61	0.5367	1386.17	-0.67
3-Jan-92	2	1.0000	1407.90	0.01	3-Feb-92	33	0.8660	1401.62	-0.40	3-Mar-92	62	0.5221	1385.49	-0.68
4-Jan-92	3	1.0000	1407.90	0.00	4-Feb-92	34	0.8573	1401.21	-0.41	4-Mar-92	63	0.5074	1384.80	-0.69
5-Jan-92	4	0.9997	1407.88	-0.01	5-Feb-92	35	0.8484	1400.79	-0.42	5-Mar-92	64	0.4925	1384.10	-0.70
6-Jan-92	5	0.9991	1407.86	-0.03	6-Feb-92	36	0.8391	1400.36	-0.43	6-Mar-92	65	0.4775	1383.40	-0.70
7-Jan-92	6	0.9982	1407.82	-0.04	7-Feb-92	37	0.8297	1399.91	-0.44	7-Mar-92	66	0.4624	1382.69	-0.71
8-Jan-92	7	0.9970	1407.76	-0.06	8-Feb-92	38	0.8200	1399.46	-0.46	8-Mar-92	67	0.4471	1381.97	-0.72
9-Jan-92	8	0.9955	1407.69	-0.07	9-Feb-92	39	0.8100	1398.99	-0.47	9-Mar-92	68	0.4317	1381.25	-0.72
10-Jan-92	9	0.9938	1407.61	-0.08	10-Feb-92	40	0.7998	1398.51	-0.48	10-Mar-92	69	0.4161	1380.52	-0.73
11-Jan-92	10	0.9917	1407.51	-0.10	11-Feb-92	41	0.7894	1398.02	-0.49	11-Mar-92	70	0.4005	1379.78	-0.73
12-Jan-92	11	0.9894	1407.40	-0.11	12-Feb-92	42	0.7788	1397.52	-0.50	12-Mar-92	71	0.3847	1379.04	-0.74
13-Jan-92	12	0.9867	1407.28	-0.12	13-Feb-92	43	0.7679	1397.01	-0.51	13-Mar-92	72	0.3688	1378.29	-0.74
14-Jan-92	13	0.9838	1407.14	-0.14	14-Feb-92	44	0.7568	1396.49	-0.52	14-Mar-92	73	0.3528	1377.54	-0.75
15-Jan-92	14	0.9806	1406.99	-0.15	15-Feb-92	45	0.7454	1395.96	-0.53	15-Mar-92	74	0.3366	1376.79	-0.76
16-Jan-92	15	0.9771	1406.82	-0.16	16-Feb-92	46	0.7339	1395.42	-0.54	16-Mar-92	75	0.3204	1376.03	-0.76
17-Jan-92	16	0.9733	1406.65	-0.18	17-Feb-92	47	0.7221	1394.87	-0.55	17-Mar-92	76	0.3041	1375.26	-0.76
18-Jan-92	17	0.9692	1406.45	-0.19	18-Feb-92	48	0.7101	1394.31	-0.56	18-Mar-92	77	0.2877	1374.49	-0.77
19-Jan-92	18	0.9648	1406.25	-0.21	19-Feb-92	49	0.6979	1393.73	-0.57	19-Mar-92	78	0.2712	1373.72	-0.77
20-Jan-92	19	0.9601	1406.03	-0.22	20-Feb-92	50	0.6855	1393.15	-0.58	20-Mar-92	79	0.2547	1372.94	-0.78
21-Jan-92	20	0.9552	1405.80	-0.23	21-Feb-92	51	0.6729	1392.56	-0.59	21-Mar-92	80	0.2380	1372.16	-0.78
22-Jan-92	21	0.9500	1405.55	-0.24	22-Feb-92	52	0.6602	1391.96	-0.60	22-Mar-92	81	0.2213	1371.38	-0.78
23-Jan-92	22	0.9445	1405.30	-0.26	23-Feb-92	53	0.6472	1391.35	-0.61	23-Mar-92	82	0.2046	1370.59	-0.79
24-Jan-92	23	0.9387	1405.03	-0.27	24-Feb-92	54	0.6340	1390.73	-0.62	24-Mar-92	83	0.1877	1369.80	-0.79
25-Jan-92	24	0.9327	1404.74	-0.28	25-Feb-92	55	0.6206	1390.11	-0.63	25-Mar-92	84	0.1708	1369.01	-0.79
26-Jan-92	25	0.9263	1404.44	-0.30	26-Feb-92	56	0.6071	1389.47	-0.64	26-Mar-92	85	0.1539	1368.22	-0.80
27-Jan-92	26	0.9197	1404.13	-0.31	27-Feb-92	57	0.5933	1388.83	-0.64	27-Mar-92	86	0.1369	1367.42	-0.80
28-Jan-92	27	0.9128	1403.81	-0.32	28-Feb-92	58	0.5794	1388.17	-0.65	28-Mar-92	87	0.1199	1366.62	-0.80
29-Jan-92	28	0.9057	1403.48	-0.34	29-Feb-92	59	0.5653	1387.51	-0.66	29-Mar-92	88	0.1028	1365.82	-0.80
30-Jan-92	29	0.8983	1403.13	-0.35						30-Mar-92	89	0.0857	1365.02	-0.80
31-Jan-92	30	0.8906	1402.77	-0.36						31-Mar-92	90	0.0686	1364.22	-0.80

Table S2: Daily approximation of TSI values (W/m2) and daily rate of change (TSI Var) during 1992 (April to June inclusive). Calculations for TSU values are based on the Julian Day (JD) and associated sine value, where (i) y=sin(2π x ((JD-277)/366)), and (ii) TSI =1361+(y*46.9).

Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2
1-Apr-92	91	0.0515	1363.41	-0.81	1-May-92	121	-0.4471	1340.03	-0.72	1-Jun-92	152	-0.8391	1321.64	-0.44
2-Apr-92	92	0.0343	1362.61	-0.81	2-May-92	122	-0.4624	1339.31	-0.72	2-Jun-92	153	-0.8484	1321.21	-0.43
3-Apr-92	93	0.0172	1361.81	-0.81	3-May-92	123	-0.4775	1338.60	-0.71	3-Jun-92	154	-0.8573	1320.79	-0.42
4-Apr-92	94	0.0000	1361.00	-0.81	4-May-92	124	-0.4925	1337.90	-0.70	4-Jun-92	155	-0.8660	1320.38	-0.41
5-Apr-92	95	-0.0172	1360.19	-0.81	5-May-92	125	-0.5074	1337.20	-0.70	5-Jun-92	156	-0.8745	1319.99	-0.40
6-Apr-92	96	-0.0343	1359.39	-0.81	6-May-92	126	-0.5221	1336.51	-0.69	6-Jun-92	157	-0.8827	1319.60	-0.38
7-Apr-92	97	-0.0515	1358.59	-0.81	7-May-92	127	-0.5367	1335.83	-0.68	7-Jun-92	158	-0.8906	1319.23	-0.37
8-Apr-92	98	-0.0686	1357.78	-0.81	8-May-92	128	-0.5511	1335.15	-0.68	8-Jun-92	159	-0.8983	1318.87	-0.36
9-Apr-92	99	-0.0857	1356.98	-0.81	9-May-92	129	-0.5653	1334.49	-0.67	9-Jun-92	160	-0.9057	1318.52	-0.35
10-Apr-92	100	-0.1028	1356.18	-0.80	10-May-92	130	-0.5794	1333.83	-0.66	10-Jun-92	161	-0.9128	1318.19	-0.34
11-Apr-92	101	-0.1199	1355.38	-0.80	11-May-92	131	-0.5933	1333.17	-0.65	11-Jun-92	162	-0.9197	1317.87	-0.32
12-Apr-92	102	-0.1369	1354.58	-0.80	12-May-92	132	-0.6071	1332.53	-0.64	12-Jun-92	163	-0.9263	1317.56	-0.31
13-Apr-92	103	-0.1539	1353.78	-0.80	13-May-92	133	-0.6206	1331.89	-0.64	13-Jun-92	164	-0.9327	1317.26	-0.30
14-Apr-92	104	-0.1708	1352.99	-0.80	14-May-92	134	-0.6340	1331.27	-0.63	14-Jun-92	165	-0.9387	1316.97	-0.28
15-Apr-92	105	-0.1877	1352.20	-0.80	15-May-92	135	-0.6472	1330.65	-0.62	15-Jun-92	166	-0.9445	1316.70	-0.27
16-Apr-92	106	-0.2046	1351.41	-0.79	16-May-92	136	-0.6602	1330.04	-0.61	16-Jun-92	167	-0.9500	1316.45	-0.26
17-Apr-92	107	-0.2213	1350.62	-0.79	17-May-92	137	-0.6729	1329.44	-0.60	17-Jun-92	168	-0.9552	1316.20	-0.24
18-Apr-92	108	-0.2380	1349.84	-0.79	18-May-92	138	-0.6855	1328.85	-0.59	18-Jun-92	169	-0.9601	1315.97	-0.23
19-Apr-92	109	-0.2547	1349.06	-0.78	19-May-92	139	-0.6979	1328.27	-0.58	19-Jun-92	170	-0.9648	1315.75	-0.22
20-Apr-92	110	-0.2712	1348.28	-0.78	20-May-92	140	-0.7101	1327.69	-0.57	20-Jun-92	171	-0.9692	1315.55	-0.21
21-Apr-92	111	-0.2877	1347.51	-0.78	21-May-92	141	-0.7221	1327.13	-0.56	21-Jun-92	172	-0.9733	1315.35	-0.19
22-Apr-92	112	-0.3041	1346.74	-0.77	22-May-92	142	-0.7339	1326.58	-0.55	22-Jun-92	173	-0.9771	1315.18	-0.18
23-Apr-92	113	-0.3204	1345.97	-0.77	23-May-92	143	-0.7454	1326.04	-0.54	23-Jun-92	174	-0.9806	1315.01	-0.16
24-Apr-92	114	-0.3366	1345.21	-0.76	24-May-92	144	-0.7568	1325.51	-0.53	24-Jun-92	175	-0.9838	1314.86	-0.15
25-Apr-92	115	-0.3528	1344.46	-0.76	25-May-92	145	-0.7679	1324.99	-0.52	25-Jun-92	176	-0.9867	1314.72	-0.14
26-Apr-92	116	-0.3688	1343.71	-0.76	26-May-92	146	-0.7788	1324.48	-0.51	26-Jun-92	177	-0.9894	1314.60	-0.12
27-Apr-92	117	-0.3847	1342.96	-0.75	27-May-92	147	-0.7894	1323.98	-0.50	27-Jun-92	178	-0.9917	1314.49	-0.11
28-Apr-92	118	-0.4005	1342.22	-0.74	28-May-92	148	-0.7998	1323.49	-0.49	28-Jun-92	179	-0.9938	1314.39	-0.10
29-Apr-92	119	-0.4161	1341.48	-0.74	29-May-92	149	-0.8100	1323.01	-0.48	29-Jun-92	180	-0.9955	1314.31	-0.08
30-Apr-92	120	-0.4317	1340.75	-0.73	30-May-92	150	-0.8200	1322.54	-0.47	30-Jun-92	181	-0.9970	1314.24	-0.07
					31-May-92	151	-0.8297	1322.09	-0.46					

Table S3: Daily approximation of TSI values (W/m2) and daily rate of change (TSI Var) during 1992 (July to September inclusive). Calculations for TSU values are based on the Julian Day (JD) and associated sine value, where (i) y=sin(2π x ((JD-277)/366)), and (ii) TSI =1361+(y*46.9).

Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2
1-Jul-92	182	-0.9982	1314.20	-0.04	1-Aug-92	213	-0.8906	1319.23	0.42	1-Sep-92	244	-0.5367	1335.83	0.68
2-Jul-92	183	-0.9991	1314.15	-0.05	2-Aug-92	214	-0.8827	1319.60	0.37	2-Sep-92	245	-0.5221	1336.51	0.68
3-Jul-92	184	-0.9997	1314.12	-0.03	3-Aug-92	215	-0.8745	1319.99	0.38	3-Sep-92	246	-0.5074	1337.20	0.69
4-Jul-92	185	-1.0000	1314.10	-0.02	4-Aug-92	216	-0.8660	1320.38	0.40	4-Sep-92	247	-0.4925	1337.90	0.70
5-Jul-92	186	-1.0000	1314.10	0.00	5-Aug-92	217	-0.8573	1320.79	0.41	5-Sep-92	248	-0.4775	1338.60	0.70
6-Jul-92	187	-0.9997	1314.11	0.01	6-Aug-92	218	-0.8484	1321.21	0.42	6-Sep-92	249	-0.4624	1339.31	0.71
7-Jul-92	188	-0.9991	1314.14	0.02	7-Aug-92	219	-0.8391	1321.64	0.43	7-Sep-92	250	-0.4471	1340.03	0.72
8-Jul-92	189	-0.9982	1314.17	0.04	8-Aug-92	220	-0.8297	1322.09	0.44	8-Sep-92	251	-0.4317	1340.75	0.72
9-Jul-92	190	-0.9970	1314.23	0.05	9-Aug-92	221	-0.8200	1322.54	0.46	9-Sep-92	252	-0.4161	1341.48	0.73
10-Jul-92	191	-0.9955	1314.29	0.07	10-Aug-92	222	-0.8100	1323.01	0.47	10-Sep-92	253	-0.4005	1342.22	0.73
11-Jul-92	192	-0.9938	1314.37	0.08	11-Aug-92	223	-0.7998	1323.49	0.48	11-Sep-92	254	-0.3847	1342.96	0.74
12-Jul-92	193	-0.9917	1314.46	0.09	12-Aug-92	224	-0.7894	1323.98	0.49	12-Sep-92	255	-0.3688	1343.71	0.75
13-Jul-92	194	-0.9894	1314.57	0.11	13-Aug-92	225	-0.7788	1324.48	0.50	13-Sep-92	256	-0.3528	1344.46	0.75
14-Jul-92	195	-0.9867	1314.69	0.12	14-Aug-92	226	-0.7679	1324.99	0.51	14-Sep-92	257	-0.3366	1345.21	0.76
15-Jul-92	196	-0.9838	1314.83	0.13	15-Aug-92	227	-0.7568	1325.51	0.52	15-Sep-92	258	-0.3204	1345.97	0.76
16-Jul-92	197	-0.9806	1314.98	0.15	16-Aug-92	228	-0.7454	1326.04	0.53	16-Sep-92	259	-0.3041	1346.74	0.76
17-Jul-92	198	-0.9771	1315.14	0.16	17-Aug-92	229	-0.7339	1326.58	0.54	17-Sep-92	260	-0.2877	1347.51	0.77
18-Jul-92	199	-0.9733	1315.31	0.18	18-Aug-92	230	-0.7221	1327.13	0.55	18-Sep-92	261	-0.2712	1348.28	0.77
19-Jul-92	200	-0.9692	1315.50	0.19	19-Aug-92	231	-0.7101	1327.69	0.56	19-Sep-92	262	-0.2547	1349.06	0.78
20-Jul-92	201	-0.9648	1315.71	0.20	20-Aug-92	232	-0.6979	1328.27	0.57	20-Sep-92	263	-0.2380	1349.84	0.78
21-Jul-92	202	-0.9601	1315.92	0.22	21-Aug-92	233	-0.6855	1328.85	0.58	21-Sep-92	264	-0.2213	1350.62	0.78
22-Jul-92	203	-0.9552	1316.15	0.23	22-Aug-92	234	-0.6729	1329.44	0.59	22-Sep-92	265	-0.2046	1351.41	0.79
23-Jul-92	204	-0.9500	1316.40	0.24	23-Aug-92	235	-0.6602	1330.04	0.60	23-Sep-92	266	-0.1877	1352.20	0.79
24-Jul-92	205	-0.9445	1316.65	0.26	24-Aug-92	236	-0.6472	1330.65	0.61	24-Sep-92	267	-0.1708	1352.99	0.79
25-Jul-92	206	-0.9387	1316.92	0.27	25-Aug-92	237	-0.6340	1331.27	0.62	25-Sep-92	268	-0.1539	1353.78	0.79
26-Jul-92	207	-0.9327	1317.20	0.28	26-Aug-92	238	-0.6206	1331.89	0.63	26-Sep-92	269	-0.1369	1354.58	0.80
27-Jul-92	208	-0.9263	1317.50	0.30	27-Aug-92	239	-0.6071	1332.53	0.64	27-Sep-92	270	-0.1199	1355.38	0.80
28-Jul-92	209	-0.9197	1317.81	0.31	28-Aug-92	240	-0.5933	1333.17	0.64	28-Sep-92	271	-0.1028	1356.18	0.80
29-Jul-92	210	-0.9128	1318.13	0.32	29-Aug-92	241	-0.5794	1333.83	0.65	29-Sep-92	272	-0.0857	1356.98	0.80
30-Jul-92	211	-0.9057	1318.46	0.33	30-Aug-92	242	-0.5653	1334.49	0.66	30-Sep-92	273	-0.0686	1357.78	0.80
31-Jul-92	212	-0.8983	1318.81	0.35	31-Aug-92	243	-0.5511	1335.15	0.67					

Table S4: Daily approximation of TSI values (W/m2) and daily rate of change (TSI Var) during 1992 (October to December inclusive). Calculations for TSU values are based on the Julian Day (JD) and associated sine value, where (i) y=sin(2π x ((JD-277)/366)), and (ii) TSI =1361+(y*46.9).

Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2	Date	JD	Sine value	TSI W/m2	TSI Var W/m2
1-Oct-92	274	-0.0515	1358.59	0.80	1-Nov-92	305	0.4624	1382.69	0.72	1-Dec-92	335	0.8391	1400.36	0.44
2-Oct-92	275	-0.0343	1359.39	0.80	2-Nov-92	306	0.4775	1383.40	0.71	2-Dec-92	336	0.8484	1400.79	0.43
3-Oct-92	276	-0.0172	1360.19	0.80	3-Nov-92	307	0.4925	1384.10	0.70	3-Dec-92	337	0.8573	1401.21	0.42
4-Oct-92	277	0.0000	1361.00	0.81	4-Nov-92	308	0.5074	1384.80	0.70	4-Dec-92	338	0.8660	1401.62	0.41
5-Oct-92	278	0.0172	1361.81	0.81	5-Nov-92	309	0.5221	1385.49	0.69	5-Dec-92	339	0.8745	1402.01	0.40
6-Oct-92	279	0.0343	1362.61	0.80	6-Nov-92	310	0.5367	1386.17	0.68	6-Dec-92	340	0.8827	1402.40	0.38
7-Oct-92	280	0.0515	1363.41	0.80	7-Nov-92	311	0.5511	1386.85	0.68	7-Dec-92	341	0.8906	1402.77	0.37
8-Oct-92	281	0.0686	1364.22	0.80	8-Nov-92	312	0.5653	1387.51	0.67	8-Dec-92	342	0.8983	1403.13	0.36
9-Oct-92	282	0.0857	1365.02	0.80	9-Nov-92	313	0.5794	1388.17	0.66	9-Dec-92	343	0.9057	1403.48	0.35
10-Oct-92	283	0.1028	1365.82	0.80	10-Nov-92	314	0.5933	1388.83	0.65	10-Dec-92	344	0.9128	1403.81	0.34
11-Oct-92	284	0.1199	1366.62	0.80	11-Nov-92	315	0.6071	1389.47	0.64	11-Dec-92	345	0.9197	1404.13	0.32
12-Oct-92	285	0.1369	1367.42	0.80	12-Nov-92	316	0.6206	1390.11	0.64	12-Dec-92	346	0.9263	1404.44	0.31
13-Oct-92	286	0.1539	1368.22	0.80	13-Nov-92	317	0.6340	1390.73	0.63	13-Dec-92	347	0.9327	1404.74	0.30
14-Oct-92	287	0.1708	1369.01	0.79	14-Nov-92	318	0.6472	1391.35	0.62	14-Dec-92	348	0.9387	1405.03	0.28
15-Oct-92	288	0.1877	1369.80	0.79	15-Nov-92	319	0.6602	1391.96	0.61	15-Dec-92	349	0.9445	1405.30	0.27
16-Oct-92	289	0.2046	1370.59	0.79	16-Nov-92	320	0.6729	1392.56	0.60	16-Dec-92	350	0.9500	1405.55	0.26
17-Oct-92	290	0.2213	1371.38	0.79	17-Nov-92	321	0.6855	1393.15	0.59	17-Dec-92	351	0.9552	1405.80	0.24
18-Oct-92	291	0.2380	1372.16	0.78	18-Nov-92	322	0.6979	1393.73	0.58	18-Dec-92	352	0.9601	1406.03	0.23
19-Oct-92	292	0.2547	1372.94	0.78	19-Nov-92	323	0.7101	1394.31	0.57	19-Dec-92	353	0.9648	1406.25	0.22
20-Oct-92	293	0.2712	1373.72	0.78	20-Nov-92	324	0.7221	1394.87	0.56	20-Dec-92	354	0.9692	1406.45	0.21
21-Oct-92	294	0.2877	1374.49	0.77	21-Nov-92	325	0.7339	1395.42	0.55	21-Dec-92	355	0.9733	1406.65	0.19
22-Oct-92	295	0.3041	1375.26	0.77	22-Nov-92	326	0.7454	1395.96	0.54	22-Dec-92	356	0.9771	1406.82	0.18
23-Oct-92	296	0.3204	1376.03	0.76	23-Nov-92	327	0.7568	1396.49	0.53	23-Dec-92	357	0.9806	1406.99	0.16
24-Oct-92	297	0.3366	1376.79	0.76	24-Nov-92	328	0.7679	1397.01	0.52	24-Dec-92	358	0.9838	1407.14	0.15
25-Oct-92	298	0.3528	1377.54	0.76	25-Nov-92	329	0.7788	1397.52	0.51	25-Dec-92	359	0.9867	1407.28	0.14
26-Oct-92	299	0.3688	1378.29	0.75	26-Nov-92	330	0.7894	1398.02	0.50	26-Dec-92	360	0.9894	1407.40	0.12
27-Oct-92	300	0.3847	1379.04	0.75	27-Nov-92	331	0.7998	1398.51	0.49	27-Dec-92	361	0.9917	1407.51	0.11
28-Oct-92	301	0.4005	1379.78	0.74	28-Nov-92	332	0.8100	1398.99	0.48	28-Dec-92	362	0.9938	1407.61	0.10
29-Oct-92	302	0.4161	1380.52	0.73	29-Nov-92	333	0.8200	1399.46	0.47	29-Dec-92	363	0.9955	1407.69	0.08
30-Oct-92	303	0.4317	1381.25	0.73	30-Nov-92	334	0.8297	1399.91	0.46	30-Dec-92	364	0.9970	1407.76	0.07
31-Oct-92	304	0.4471	1381.97	0.72						31-Dec-92	365	0.9982	1407.82	0.06

Table S5: Table of cycles. Palaeooclimatic and modern climatic cycles and their associations

Cycle	Length (Mean)	Range/Variants	Multiples/Association	Records
3.8 yr				El Nino periodicity in NINO3.4; SST
18.6 yr				Lunar nodal cycle; tidal sedimentation; air-pressure
19 yr			Metonic lunation cycle 38 yrs; 57 yrs; 494 yrs	Be_{10} spectral peak in Holocene ice; air pressure; air temperature; precipitation data; PDO
57 yr	57 yrs		114 yrs, 228 yrs	Radiocarbon; PDO; North Atlantic Oscillation; global air temperature; length of day
104 yr	104 yrs		208 yrs, 416 yrs	Radiocarbon
131 yr	131 yrs			Radiocarbon; ice-cores; tropical Atlantic cyclones; ocean sediments; Nile water levels; auroral records; fire and drought cycles in China, Spain and Indonesia; arctic atmospheric oscillation; solar insolation; periodic variation in the interhemispheric offset of radiocarbon ages;
Bruckner	32.5 yrs	30-35 yrs		dendrochronology;
Bond	1470±532 yrs			Radiocarbon
Cartwright sedimentation	~493 yrs			Radiocarbon; tidal sediments
Dansgaard-Oeschger	1ky-12ky		Occurs at multiples of 1470 yrs	Ice-cores, deep-sea sedimentary cores
ENSO (millennial scale)	~1490 yrs			Peat humification data; radiocarbon
Gleissberg		70 yrs -100 yrs	77 yr; 88 yr	Radiocarbon; dendrochronology; ice-cores; harmonic of sunspot cycle
Hale	22.8 yr		57 yrs; sunspot cycle	Sunspot data (TSI, radio flux, magnetic, flares/CMEs, galactic cosmic ray flux); dendrochronology; ice-cores; strength of cyclogenesis; land air; SST; sea-level pressure; atmospheric pressure; equatorial wind patterns; the intensity of zonal flow
Hallstadt	~2.3ky			Radiocarbon; Palaeomagnetic; reconstructed sunspot numbers; ice-cores
Heinrich events	11±1ky		Occurs at multiples of 1470 yrs	Ice-cores, deep-sea sedimentary cores
~100ky			Milankovitch (obliquity)	Mathematical; oxygen isotopes from deep-sea sediment cores; uranium series dating coral terraces; geomagnetic dating
~41ky			Milankovitch (eccentricity)	Mathematical; oxygen isotopes from deep-sea sediment cores; uranium series dating coral terraces; geomagnetic dating
~21ky	~19ky, ~23ky	~11.5ky half cycle	Milankovitch precession	Mathematical; oxygen isotopes from deep-sea sediment cores; uranium series dating coral terraces; geomagnetic dating; radiocarbon
Schwabe	11.4 yrs		Sunspot cycle	Sunspot data (TSI, radio flux, magnetic, flares/CMEs, galactic cosmic ray flux); dendrochronology; strength of cyclogenesis; land air; SST; sea-level pressure; atmospheric pressure; equatorial wind patterns; the intensity of zonal flow
Suess de Vries	~208 yrs	171-235 yrs		Radiocarbon; ice-cores; harmonic of sunspot cycle; dendrochronology; glacier variations; ice core chronologies; monsoon intensity changes

Refs: (Attolini et al., 1990, Biagioni et al., 2015, Bond and Lotti, 1995, Bond et al., 1997, Bond et al., 1999, Bond et al., 2001, Branch et al., 2005, Chambers et al., 2012, Cohen and Sweetser, 1975, Currie, 1993, Damon and Linick, 1986, Damon and Sonett, 1991, Darby et al., 2012, Eddy, 1976, Edvardsson et al., 2011, Hamilton, 1973, Henry, 1927, Keele, 1910, Mayewski et al., 1997, Mazarella, 2008, Munk et al., 2002, Mörner, 2013, O'Brien and Currie, 1993, Oost et al., 1993, Raspopov et al., 2011, Siscoe, 1980, Sonett and Suess, 1984, Stuiver, 1961, Stuiver and Quay, 1980, Stuiver and Braziunas, 1989, Stuiver et al., 1995, Stuiver and Braziunas, 1998, Vázquez et al., 2015, Vines, 2008, Xue et al., 2008, Yiou et al., 1997, Yousef, 2000).

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