NASA/TP—2006–214601

On The Relationship Between Spotless Days and the Sunspot Cycle: A Supplement

Robert M. Wilson and David H. Hathaway
Marshall Space Flight Center, Marshall Space Flight Center, Alabama

August 2006

The NASA STI Program Office…in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.

- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.

- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.

- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.

- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results…even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at ***http://www.sti.nasa.gov***

- E-mail your question via the Internet to help@sti.nasa.gov

- Fax your question to the NASA Access Help Desk at 301–621–0134

- Telephone the NASA Access Help Desk at 301–621–0390

- Write to:
  NASA Access Help Desk
  NASA Center for AeroSpace Information
  7121 Standard Drive
  Hanover, MD 21076–1320
  301–621–0390

NASA/TP—2006–214601

On The Relationship Between Spotless Days and the Sunspot Cycle: A Supplement

Robert M. Wilson and David H. Hathaway
Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and
Space Administration

Marshall Space Flight Center • MSFC, Alabama 35812

August 2006

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076–1320
301–621–0390

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
703–487–4650

NASA publications are available online at
http://trs.nis.nasa.gov/.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

cl	confidence level
E	epoch
$E(FSD)$	epoch of first spotless day
$E(LSD)$	epoch of last spotless day
$E(Rm)$	epoch of occurrence of sunspot minimum
$E(RM)$	epoch of occurrence of sunspot maximum
$E(\mathrm{NSD}_{10f})$	epoch of first occurrence of 10 or more spotless days
$E(\mathrm{NSD}_{15f})$	epoch of first occurrence of 15 or more spotless days
$E(\mathrm{NSD}_{20f})$	epoch of first occurrence of 20 or more spotless days
f	first occurrence
L	long-period cycles
l	last occurrence
$<L>$	average length of long-period cycles in months
M	maximum
n	cycle number
NOAA	National Oceanic and Atmospheric Administration
NSD	number of spotless days
NSD_{10}	elapsed time in months between $E(\mathrm{NSD}_{10f})$ for cycle n and $E(\mathrm{NSD}_{10f})$ for cycle $n+1$
NSD_{15}	elapsed time in months between $E(\mathrm{NSD}_{15f})$ for cycle n and $E(\mathrm{NSD}_{15f})$ for cycle $n+1$
NSD_{20}	elapsed time in months between $E(\mathrm{NSD}_{20f})$ for cycle n and $E(\mathrm{NSD}_{20f})$ for cycle $n+1$

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

P	probability (based on Fisher's exact test[2])
PER	period; elapsed time in months between successive cycle minima
r	coefficient of correlation
r^2	coefficient of determination
RGO/SOON	Royal Greenwich Observatory/Solar Optical Observing Network
Rm	conventional sunspot minimum amplitude
RM	conventional sunspot maximum amplitude
S	short-period cycles
$<S>$	average length of short-period cycles in months
sd	standard deviation
se	standard error of estimate
TP	Technical Publication
t	time
t_{10}	elapsed time in months from $E(\text{NSD}_{10f})$ to $E(Rm)$
t_{15}	elapsed time in months from $E(\text{NSD}_{15f})$ to $E(Rm)$
t_{20}	elapsed time in months from $E(\text{NSD}_{20f})$ to $E(Rm)$
$t_{10f\rightarrow l}$	elapsed time in months from the first occurrence of 10 or more spotless days to the last occurrence of 10 or more spotless days in a sunspot cycle
$t_{10l\rightarrow M}$	elapsed time in months from last occurrence of 10 or more spotless days to $E(RM)$ in a sunspot cycle
$t_{15f\rightarrow l}$	elapsed time in months from the first occurrence of 15 or more spotless days to the last occurrence of 15 or more spotless days in a sunspot cycle

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

$t_{15l \rightarrow M}$	elapsed time in months from the last occurrence of 15 or more spotless days to *E*(*RM*) in a sunspot cycle
$t_{20f \rightarrow l}$	elapsed time in months from the first occurrence of 20 or more spotless days to the last occurrence of 20 or more spotless days in a sunspot cycle
$t_{20l \rightarrow M}$	elapsed time in months from the last occurrence of 20 or more spotless days to *E*(*RM*) in a sunspot cycle
USAF	United States Air Force
x	independent variable
y	dependent variable
ZI	Zurich/International

TECHNICAL PUBLICATION

ON THE RELATIONSHIP BETWEEN SPOTLESS DAYS AND THE SUNSPOT CYCLE: A SUPPLEMENT

1. INTRODUCTION

NASA Technical Publication (TP)—2005–213608 described the relationship between spotless days on the Sun and the operation of the sunspot cycle, in particular, the examination of various methods that might prove useful for ascertaining the timing and size of a new sunspot cycle during the declining phase of the old sunspot cycle.[1] Interestingly, the behavior of the most recent cycles, 16–23, was found to differ markedly from that of the earlier cycles, 10–15. For cycles 16–23, the first spotless day of a new cycle, which occurs during the decline of the old cycle, was found to precede sunspot minimum amplitude for the new cycle by ≈34 mo, having a range of 25–40 mo. Because the first spotless day for cycle 24, the next sunspot cycle, occurred in January 2004, it was inferred that its minimum amplitude occurrence should come before April 2007, probably sometime during the latter half of 2006. If true, this implies that cycle 23 is a cycle of shorter period and suggests that cycle 24 will likely be a cycle of larger than average size and faster than average rise, peaking sometime in 2010. Also, TP—2005–213608 briefly noted that as the new cycle minimum approaches, the number of spotless days (NSD) increases rapidly, reaches a peak near sunspot minimum, and rapidly decreases thereafter. It is this particular aspect that will be examined more closely in this TP.

2. RESULTS AND DISCUSSION

Figure 1 displays the NSD per month for the interval January 1983 through March 2006, encompassing all of cycle 22 and most of cycle 23. The NSD is determined using daily reports issued by the Royal Observatory of Belgium, the provider of the International sunspot number. Appendix A provides the monthly NSD record using the Zurich/International (ZI) sunspot number (from the beginning of the sunspot record through 1980, the Swiss Federal Observatory in Zurich, Switzerland was responsible for daily sunspot number determinations, this responsibility was transferred to the Royal Observatory of Belgium), group sunspot number, and Royal Greenwich Observatory/United States Air Force/National Oceanic and Atmospheric Administration Solar Optical Observing Network (RGO/USAF/NOAA SOON) observations.[3–7] The thin horizontal lines in figure 1 at NSD = 10, 15, and 20 provide a reference for the reader to easily see exactly when these thresholds are met or exceeded. $E(Rm)$ and $E(RM)$ refer, respectively, to the epochs of conventional sunspot number minimum and maximum (conventional sunspot number minimum and maximum are determined using the 12-mo moving average of monthly mean sunspot number, or smoothed monthly mean sunspot number, as it is often called. ZI sunspot numbers and RGO/SOON data sets can be found, respectively, at ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/SUNSPOT_NUMBERS/ and http://solarscience.msfc.nasa.gov/RGO_NOAA.shtml).

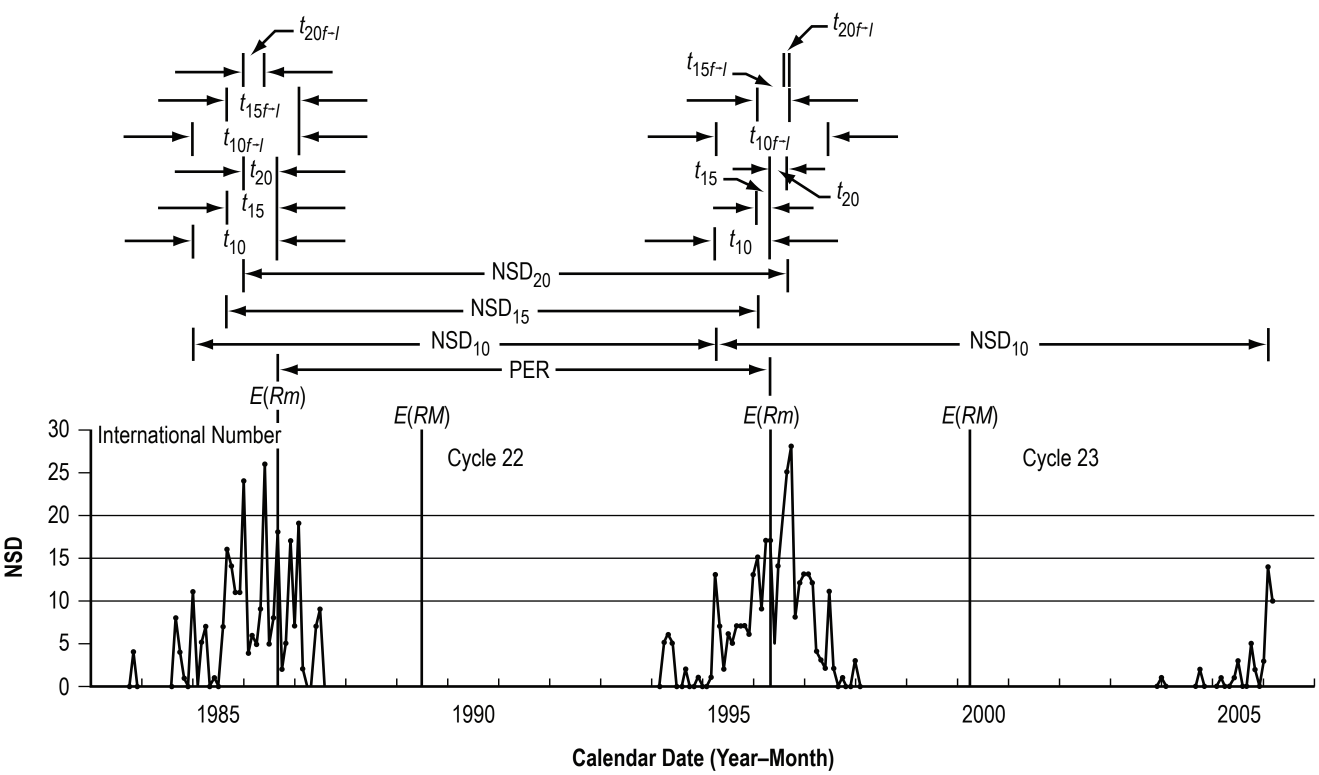

Figure 1. Variation of NSD during the interval January 1983 through March 2006.

Above the temporal variation of NSD are various selected parameters based on NSD, *E*(*Rm*), and *E*(*RM*). These parameters include the following:

- Period of the sunspot cycle (PER) computed as the elapsed time in months between successive sunspot epochs of minima.

- NSD_{10}, NSD_{15}, and NSD_{20} meaning, respectively, the elapsed time in months between successive first occurrences of 10 or more, 15 or more, and 20 or more spotless days for two succeeding sunspot cycles.

- t_{10}, t_{15}, and t_{20} meaning, respectively, the elapsed time in months between the first occurrences of 10 or more, 15 or more, and 20 or more spotless days and *E*(*Rm*) for a particular sunspot cycle.

- $t_{10f \to l}$, $t_{15f \to l}$, and $t_{20f \to l}$ meaning respectively, the elapsed time in months between the first and last occurrences of 10 or more, 15 or more, and 20 or more spotless days for a particular sunspot cycle.

Figure 1 and appendix A show that on the basis of the International sunspot number, the first occurrence of 10 or more spotless days for cycle 24, the next sunspot cycle, occurred in February 2006, with the NSD being 14 (19 were reported by SOON; and as yet, the NSD has not exceeded 15 or 20 days using the International sunspot number).

Table 1 provides values (when known) for each of these parameters for cycles 10–24, as well as the values of minimum and maximum amplitude, denoted respectively as *Rm* and *RM*. In table 1, $E(NSD_{10f})$, $E(NSD_{15f})$, and $E(NSD_{20f})$ respectively refer to the epochs of the first occurrence during the declining phase of the old cycle, when monthly NSD equals or exceeds 10, 15, and 20 days. Additionally, the elapsed time in months from the last occurrence of a parameter to maximum amplitude is given as $t_{10l \to M}$, $t_{15l \to M}$, and $t_{20l \to M}$. At the bottom of the table are the median, mean, and standard deviation (*sd*) for each of the parameters.

Figure 2 displays the cyclic variation of PER (lower panel), NSD_{10} (lower middle panel), NSD_{15} (upper middle panel), and NSD_{20} (upper panel). The median value of each parameter is identified by the thin horizontal line in each panel. Thus, for PER, seven of the last eight sunspot cycles have had a duration or cycle length measuring 126 or fewer mo (only cycle 20 is the exception), inferring that if cycle 23 continues the trend, then it too should have a conventional cycle length of 126 or fewer mo, implying conventional onset for cycle 24 (the occurrence of *E*(*Rm*)) on or before November 2006. Interestingly, when the NSD_{20} value is 129 or fewer mo, PER has almost always been equal to or shorter than 126 mo (the only exception is cycle 11); while with an NSD_{20} value longer than 129 mo, PER has almost always been equal to or longer than 135 mo (the only exception is cycle 15, the first cycle in a string of shorter-than-average length sunspot cycles). So, for 11 of 13 sunspot cycles (85 percent), the length of NSD_{20} provides a fairly reliable gauge as to the expected period class of the ongoing sunspot cycle (whether it will be of longer or shorter period). As yet, however, the occurrence of 20 or more spotless days for cycle 24 has not occurred. Through March 2006, the length of NSD_{20} for cycle 23 measures >114 mo, inferring that the first occurrence of 20 or more spotless days for cycle 24 should be imminent.

Table 1. Selected sunspot cycle parametric values and epochs of occurrence.

Cycle	*E*(*Rm*)	*E*(NSD_{10f})	*E*(NSD_{15f})	*E*(NSD_{20f})	t_{10}	t_{15}	t_{20}	PER	NSD_{10}	NSD_{15}	NSD_{20}	$t_{10f \to I}$	$t_{15f \to I}$	$t_{20f \to I}$	$t_{10I \to M}$	$t_{15I \to M}$	$t_{20I \to M}$	*Rm*	*RM*
10	12–1855	10–1854	10–1854	04–1855	14	14	8	135	132	145	140	30	29	18	34	35	40	3.2	97.9
11	03–1867	10–1865	11–1866	12–1866	17	4	3	141	123	102	105	33	10	8	25	35	36	5.2	140.5
12	12–1878	01–1875	05–1875	09–1875	47	43	39	135	142	138	134	59	51	45	48	52	54	2.2	74.6
13	03–1890	11–1886	11–1886	11–1886	40	40	40	142	140	153	153	50	42	41	45	44	36	5	87.9
14	01–1902	07–1898	08–1899	08–1899	42	29	29	139	145	135	142	62	40	40	29	38	38	2.6	64.2
15	08–1913	08–1910	11–1910	06–1911	36	33	26	120	136	141	139	49	45	33	34	36	41	1.5	105.4
16	08–1923	12–1921	08–1922	01–1923	20	12	7	121	114	121	123	37	29	14	39	39	49	5.6	78.1
17	09–1933	06–1931	09–1932	04–1933	27	12	5	125	147	136	129	42	24	9	28	31	39	3.4	119.2
18	02–1944	09–1943	01–1944	01–1944	5	1	1	122	113	109	118	10	4	4	34	36	36	7.7	151.8
19	04–1954	02–1953	02–1953	11–1953	14	14	5	126	137	137	128	26	25	10	35	36	42	3.4	201.3
20	10–1964	07–1964	07–1964	07–1964	3	3	3	140	129	129	144	12	3	0	40	49	51	9.6	110.6
21	06–1976	04–1975	04–1975	07–1976	14	14	–1	123	117	125	114	19	19	0	37	37	41	12.2	164.5
22	09–1986	01–1985	09–1985	01–1986	20	12	8	116	123	125	128	25	17	5	29	29	37	12.3	158.5
23	05–1996	04–1995	02–1996	09–1996	13	3	–4	–	130	–	–	27	8	1	33	41	41	8	120.8
24	–	02–2006	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
				Median:	18.5	13	6	126	131	135	129	31.5	24.5	9.5	34	36	40.5	5.1	114.9
				Mean:	22.3	16.7	12.1	129.6	130.6	130.5	130.5	34.4	24.7	16.3	35	38.4	41.5	5.9	119.7
				sd:	13.9	13.9	14.8	14.8	11.3	14.2	13.4	16.3	15.6	16.4	6.5	6.3	5.8	3.6	39.5

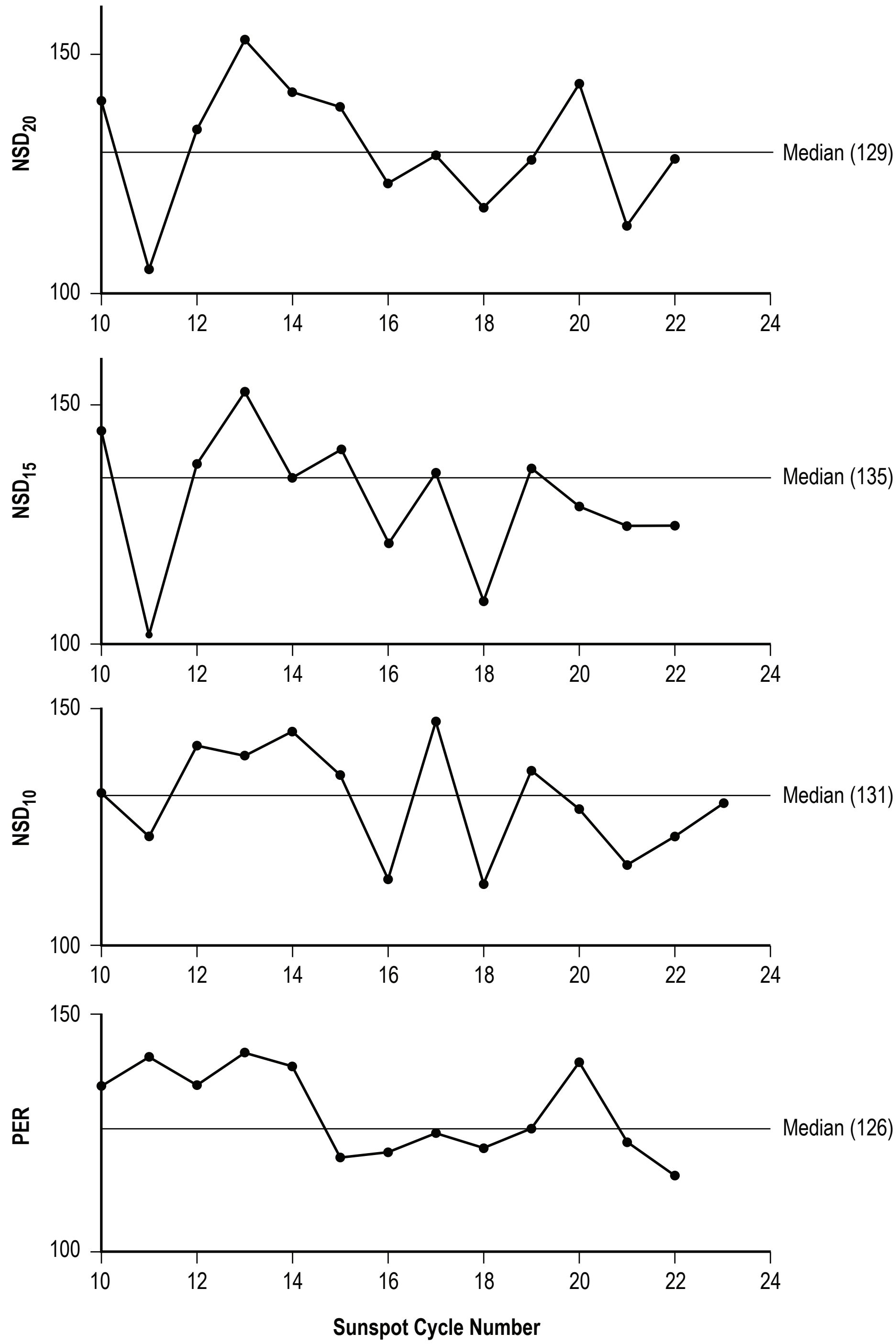

Figure 2. Cyclic variation of selected parameters for cycles 10–23.

Figure 3 depicts the scatterplots of PER versus NSD_{10} (left panel), NSD_{15} (middle panel), and NSD_{20} (right panel), respectively. Clearly, on the basis of the 12-mo moving averages, PER is distributed into two nonoverlapping groups: (1) A shorter period group (<*S*>) having an average cycle length of about 122 ± 6 mo (the 90-percent prediction interval), identified by the filled triangles; and (2) a longer period group (<*L*>), having an average length of about 139 ± 6 mo, as identified by the filled circles. Although the length of NSD_{10} is now known for cycle 23 to be equal to 130 mo (denoted by the small downward-pointing arrow in the left panel), the length of PER for cycle 23 remains ambiguous, for only four of six sunspot cycles having $NSD_{10} < 132$ mo have been members of the <*S*> group. Interestingly (see the right panel), if NSD_{20} for cycle 23 turns out to measure 129 or fewer mo, then there appears to be a much greater likelihood that cycle 23's PER will be of shorter than average length, meaning that cycle 23 very probably is a member of the <*S*> group (six of seven cycles having NSD_{20} less than or equal to 129 mo are members of the <*S*> group, while five of six having NSD_{20} greater than 129 mo are members of the <*L*> group, the exceptions being cycles 11 and 15, as previously noted and shown in the right panel).

Figure 4 displays the cyclic variation of t_{10} (lower panel), t_{15} (middle panel), and t_{20} (upper panel) for cycles 10–23. Also given are the mean, *sd*, and median values for each of the parameters. Clearly, the recent cycles 17–23 have average parametric values that are significantly lower (at the 95-percent confidence level (*cl*)) than the earlier cycles 10–16. Presuming that cycle 24's behavior will be similar to the most recent cycles 17–23, one infers that t_{10}, t_{15}, and t_{20} values for cycle 24 will likewise be less than or equal to, respectively, 27, 14, and 8 mo (actually, probably less than or equal to their median values, respectively, 18.5, 13, and 6 mo, respectively). Hence, once $E(NSD_{15f})$ occurs, one infers that $E(Rm)$ for cycle 24 should follow within 13 mo, and once $E(NSD_{20f})$ occurs, one infers that $E(Rm)$ for cycle 24 should follow within 6 mo.

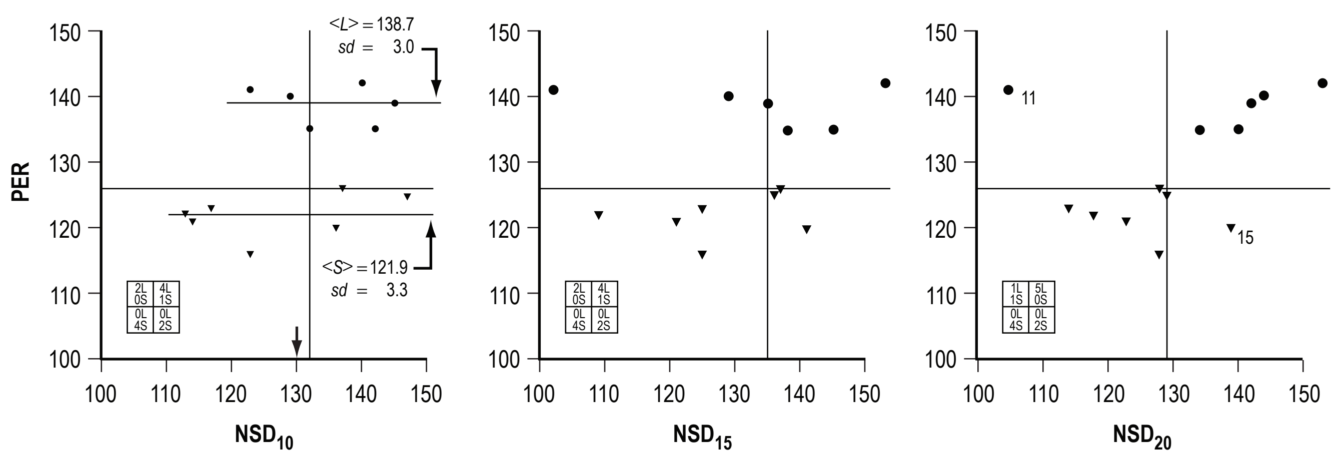

Figure 3. Selected scatterplots for PER.

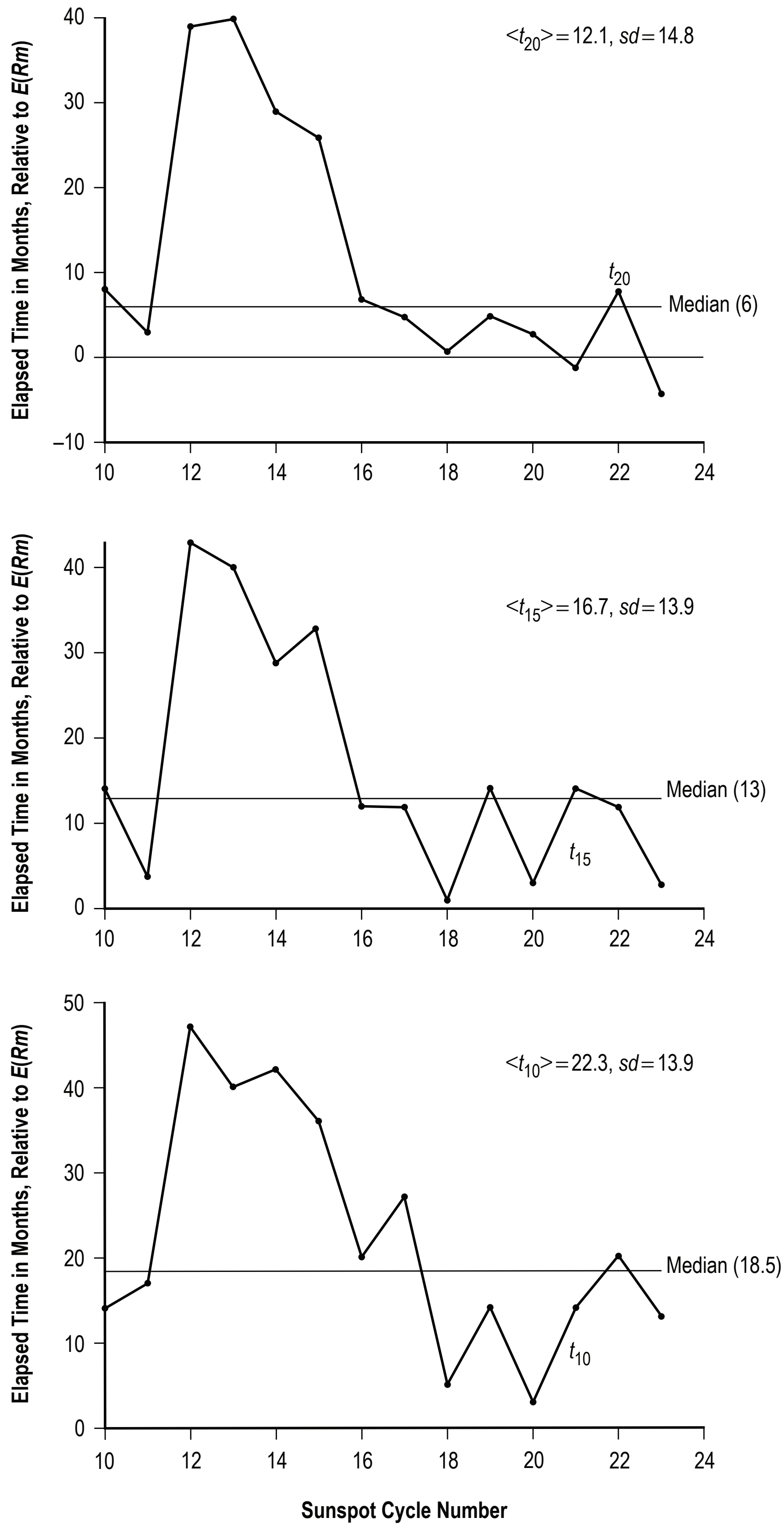

Figure 4. Cyclic variation of selected parameters for cycles 10–23.

Figure 5 shows scatterplots of *RM* (upper panels) and *Rm* (lower panels) against t_{10} (left panels), t_{15} (middle panels), and t_{20} (right panels), respectively. All inferred regressions are statistically significant, suggesting that smaller than average values of t_{10}, t_{15}, and t_{20} seem to be indicative of larger than average values of *Rm* and *RM*. The larger dot in the lower right panel merely means that two cycles (cycles 17 and 19) had the same t_{20} and *Rm* values.

Figure 6 depicts scatterplots of t_{10} for cycle n + 1 versus NSD_{10} for cycle n (left panel), t_{15} for cycle n + 1 versus NSD_{15} for cycle n (middle panel), and t_{20} for cycle n + 1 versus NSD_{20} for cycle n (right panel). The small downward pointing arrow in the left panel denotes the known value for NSD_{10} for cycle 23 (130 mo). Since 9 of 13 cycles have NSD_{10} values for the succeeding cycle in the 3–27 mo range, averaging about 15 mo, one suspects that $E(Rm)$ for cycle 24 will occur sometime in 2006 or 2007. Knowledge of NSD_{15} for cycle 23 suggests that $E(Rm)$ for cycle 24 will follow $E(\mathrm{NSD}_{15f})$ within 14 mo, averaging about 8 mo, and knowledge of NSD_{20} for cycle 23 suggests that $E(Rm)$ for cycle 24 will follow $E(\mathrm{NSD}_{20f})$ within 8 mo, averaging about 3 mo, presuming of course that cycle 24 is not a statistical outlier. The four cycles that appear separate from the main grouping are cycles 12–15.

Figure 7 displays the cyclic variation of $t_{10f\rightarrow l}$ (lower panel), $t_{15f\rightarrow l}$ (middle panel), and $t_{20f\rightarrow l}$ (upper panel) for cycles 10–23. For each parameter, cycles of late have had parametric values usually lower than the median. Presuming this trend continues, the elapsed time in months from the first to the last occurrence of 10 or more spotless days for cycle 24 should be less than 32 mo, the elapsed time from the first to the last occurrence of 15 or more spotless days should be less than 25 mo, and the elapsed time in months from the first to the last occurrence of 20 or more spotless days should be less than 10 mo.

Figure 8 shows the cyclic variation of $t_{10l\rightarrow M}$ (lower panel), $t_{15l\rightarrow M}$ (middle panel), and $t_{20l\rightarrow M}$ (upper panel). For each of the parameters, cycles of late have usually had values near the median. The elapsed time in months from the last occurrence of 10 or more spotless days to maximum amplitude has a median of 34 mo (ranging from 25 to 48 mo), the elapsed time in months from the last occurrence of 15 or more spotless days to maximum amplitude has a median of 36 mo (ranging from 29 to 52 mo), and the elapsed time in months from the last occurrence of 20 or more spotless days to maximum amplitude has a median of about 40.5 mo (ranging from 36 to 54 mo). No last occurrence of any of the parameters has yet to be seen. It may be noteworthy that a four-cycle variation in the parameters is hinted, inferring that, if the variation is real, cycle 24 will have values slightly above the medians.

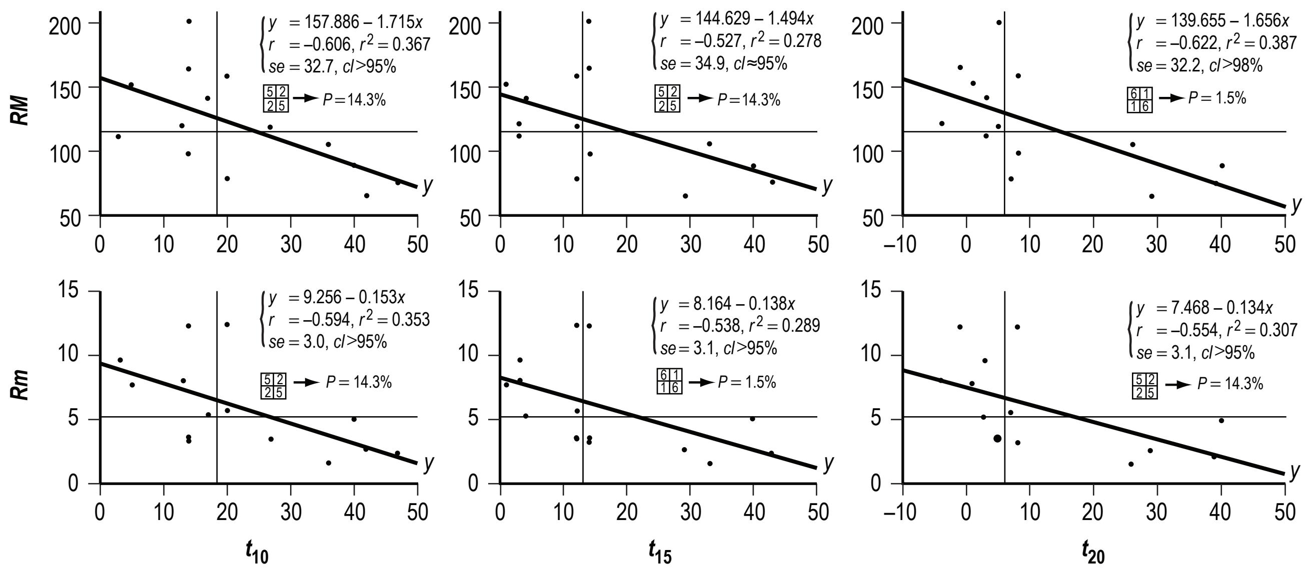

Figure 5. Scatterplots for *Rm* and *RM*.

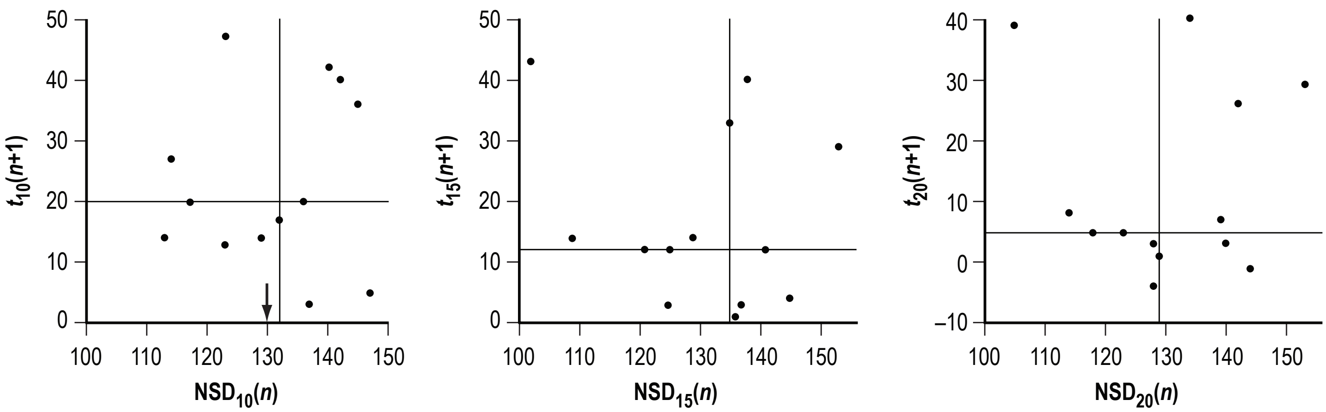

Figure 6. Selected scatterplots.

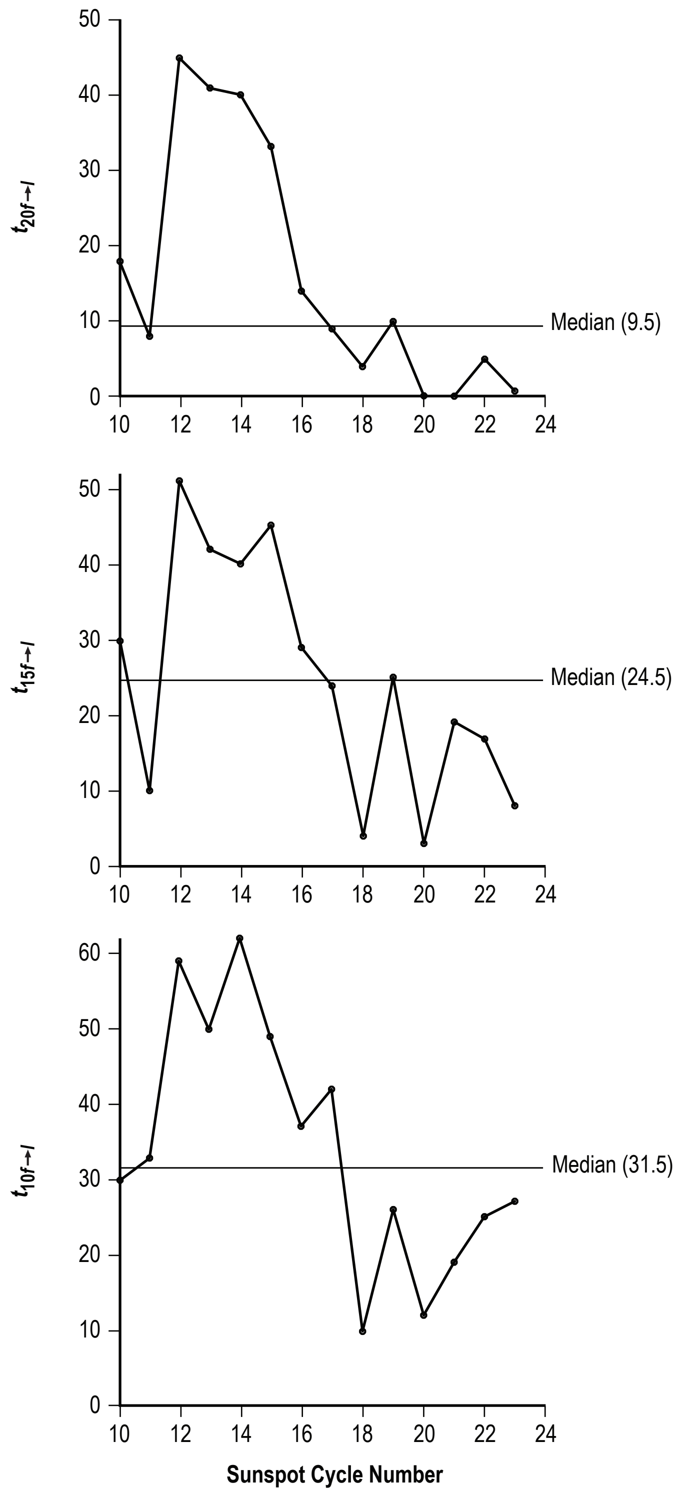

Figure 7. Selected scatterplots.

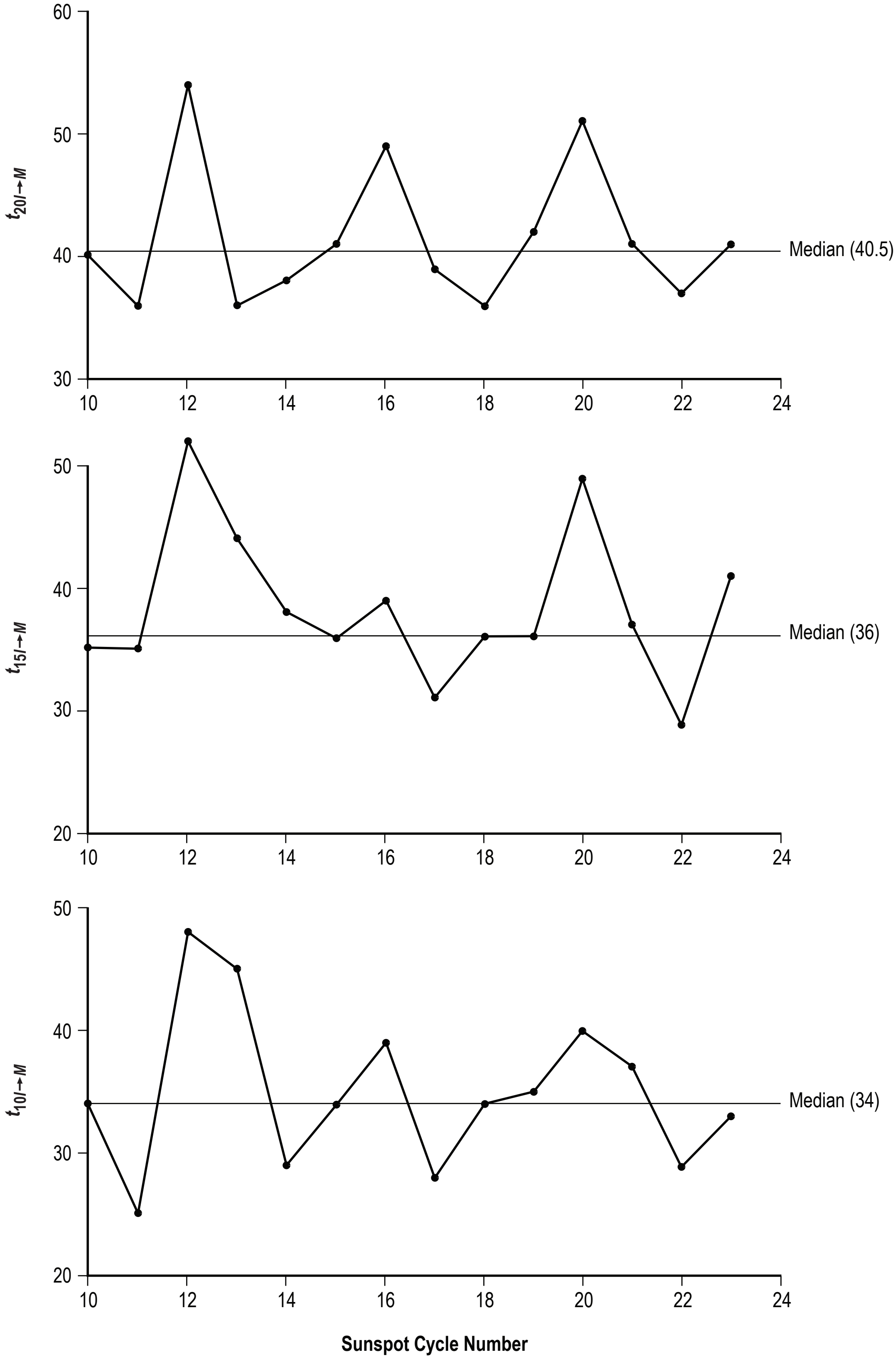

Figure 8. Selected scatterplots.

Figures 9–11 respectively display, scatterplots of *RM* (upper panels) and $t_{10l\to M}$, $t_{15l\to M}$, and $t_{20l\to M}$ (lower panels) versus $t_{10f\to l}$, $t_{15f\to l}$, and $t_{20f\to l}$. In every case, the inferred linear regressions are statistically significant, suggesting that smaller values of the elapsed times in months from the first to the last occurrence of the parameter in question strongly correlates against larger values of *RM*, while the elapsed times from the last occurrence to maximum amplitude appear to be more normally distributed.

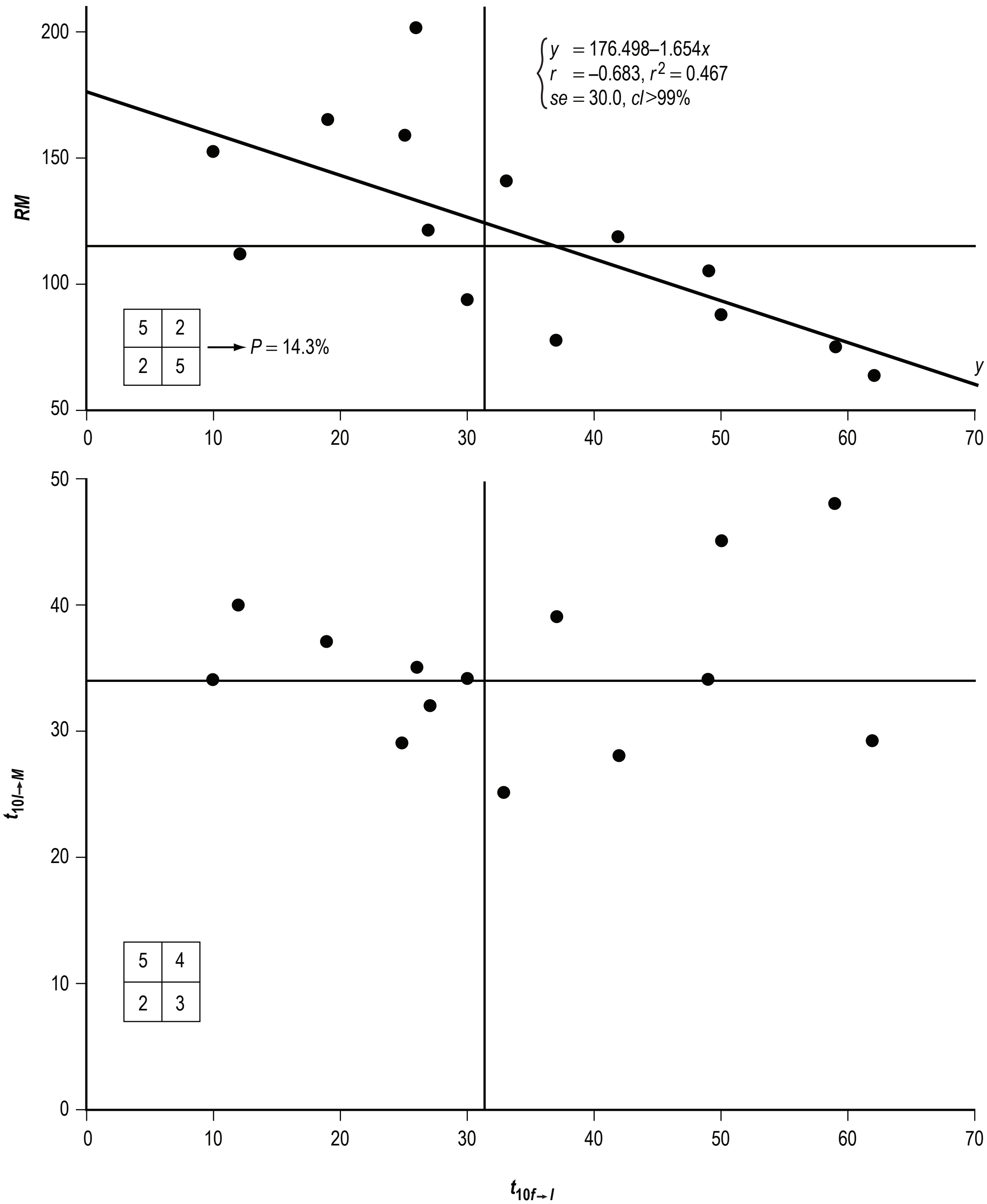

Figure 9. Selected scatterplots.

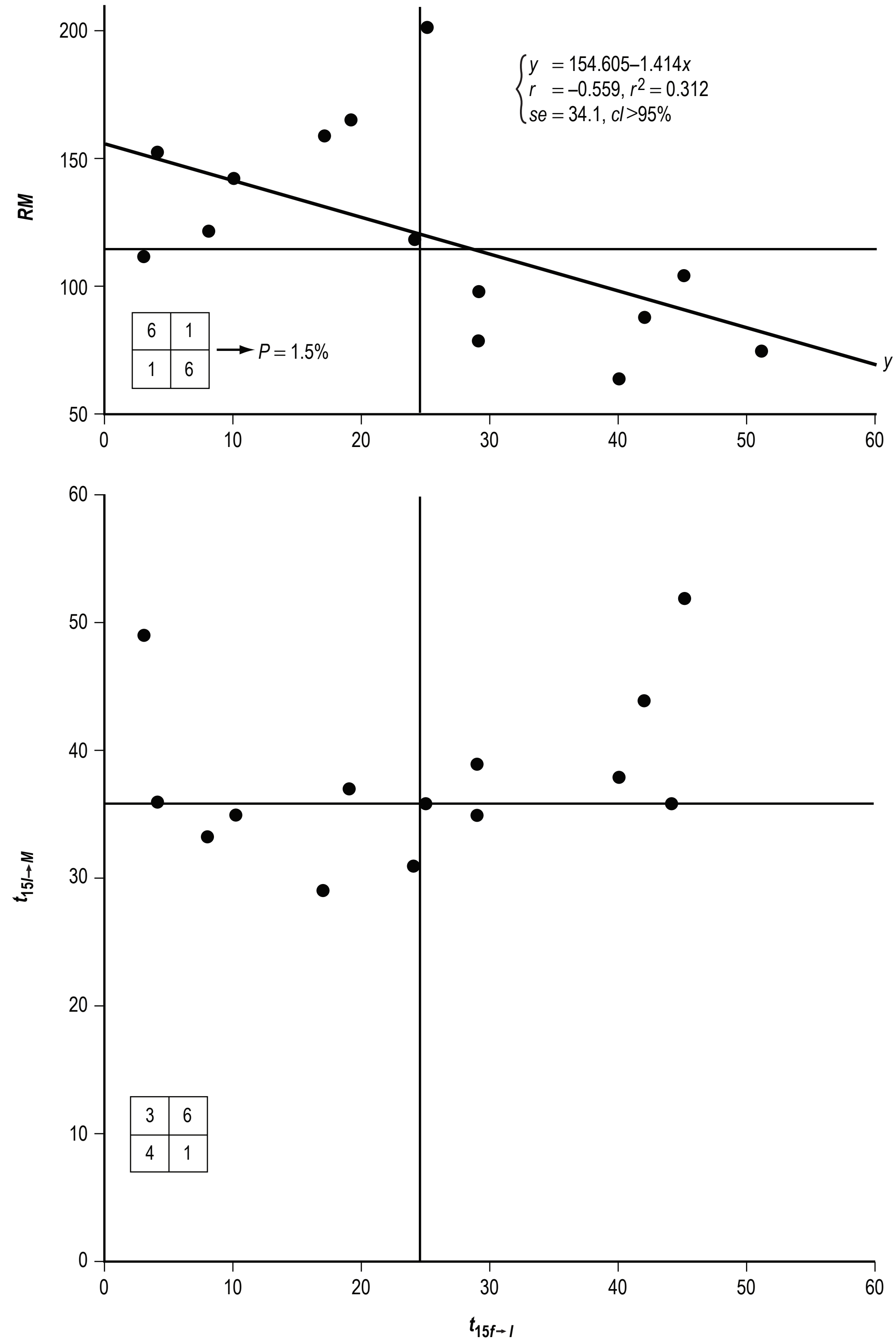

Figure 10. Selected scatterplots.

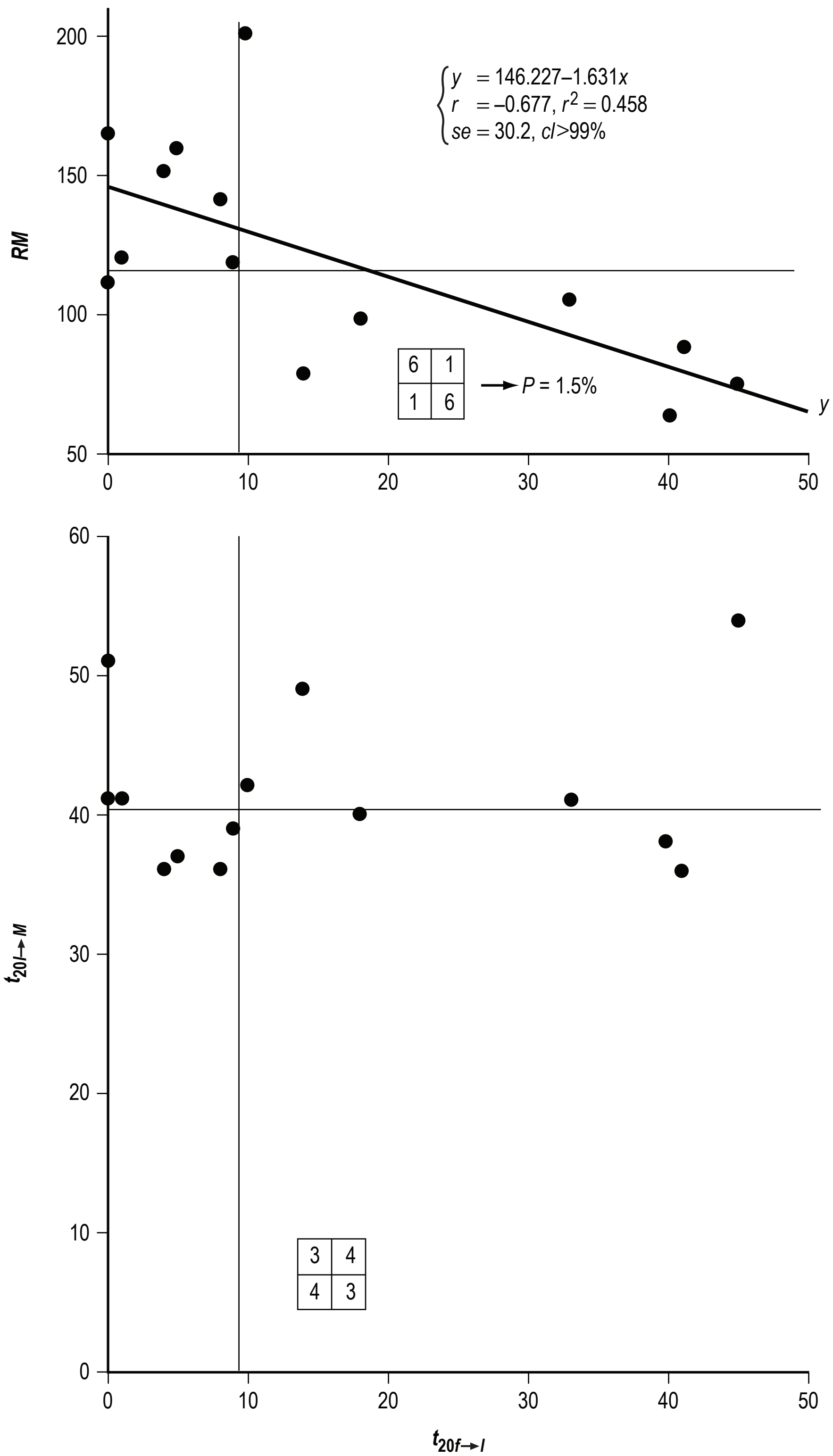

Figure 11. Selected scatterplots.

3. CONCLUSION

In the previous study, TP—2005–213608, the timing and size of sunspot minimum and maximum of a new sunspot cycle were compared to the first and last occurrences of a spotless day during the declining phase of the old cycle. It was noted that the behavior of the most recent cycles 16–23 differed substantially from that of the earlier cycles 10–15. Because the first spotless day for cycle 24 occurred in January 2004, it was suggested that sunspot minimum for cycle 24 would occur before April 2007, probably sometime during the latter half of 2006, presuming of course, that cycle 24 is similar to the most recent cycles rather than to the earlier cycles. If true, then cycle 23 would be classified as a cycle of shorter period and cycle 24 would probably be a cycle of larger than average minimum and maximum amplitudes and faster than average rise, peaking sometime in 2010.

Because the NSD rapidly increases in the vicinity of sunspot minimum and rapidly decreases thereafter, the use of higher thresholds might provide improved accuracy for determining the timing and size of the unfolding sunspot cycle. It was for this purpose that this supplemental study was performed.

This study shows that the first occurrence of 20 or more spotless days during the declining phase of the old cycle seems to serve as an accurate predictor of cycle period for the old cycle. For example, if the elapsed time in months between the first occurrences of 20 or more spotless days for the old and new sunspot cycles is less than or equal to 129 mo, then one strongly suspects that the old cycle is a cycle of shorter than average period ($<S> = 122 \pm 6$ mo, the 90-percent prediction interval), while if the elapsed time in months between the first occurrences of 20 or more spotless days for the old and new sunspot cycles is greater than 129 mo, then one strongly suspects that the old cycle is a cycle of longer than average period ($<L> = 139 \pm 6$ mo, the 90-percent prediction interval). Such a simple paradigm is found to accurately classify cycle period classes 85 percent of the time (11 of 13 sunspot cycles, with the exceptions being cycles 11 and 15).

Cycles with shorter t_{10}, t_{15}, and t_{20} values tend to be cycles of larger than average *Rm* and *RM*, and cycles with shorter $t_{10f \to l}$, $t_{15f \to l}$, and $t_{20f \to l}$ values also tend to be cycles of larger than average *RM*. Because the most recent cycles have had values of these parameters that are shorter than average, one expects both the *Rm* and *RM* for cycle 24, the next sunspot cycle, to be larger than average in size.

Table 2 in appendix A is a compilation of the three data sets (ZI, group, and RGO/SOON) that shows the occurrences of monthly counts of spotless days, spanning from January 1849 to May 2006.

APPENDIX A

A historical compilation of the three data sets (ZI, group, and RGO/SOON) reflecting the monthly occurrences of spotless days, spanning from January 1849 through May 2006 is provided in Table 2.

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data.

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
184901	0	0		
184902	0	0		
184903	0	0		
184904	0	0		
184905	1	0		Cycle 10 epoch of the first spotless day (*E*(FSD))
184906	0	0		
184907	0	0		
184908	0	0		
184909	0	0		
185910	0	0		
184911	0	0		
184912	0	0		
185001	0	0		
185002	0	0		
185003	0	0		
185004	0	0		
185005	0	0		
185006	0	0		
185007	5	4		
185008	0	0		
185009	0	0		
185010	0	0		
185011	1	1		
185012	0	0		
185101	0	0		
185102	0	0		
185103	0	0		
185104	0	0		
185105	0	0		
185106	0	0		
185107	0	0		
185108	0	0		
185109	0	0		
185110	0	0		
185111	0	0		
185112	0	0		
185201	0	0		
185202	0	0		
185203	0	0		
185204	0	0		

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
185205	0	0		
185206	1	1		
185207	2	0		
185208	0	0		
185209	1	0		
185210	0	0		
185211	0	0		
185212	0	0		
185301	0	0		
185302	0	0		
185303	2	2		
185304	1	0		
185305	0	0		
185306	1	1		
185307	1	2		
185308	0	0		
185309	1	1		
185310	0	0		
185311	0	0		
185312	0	0		
185401	6	6		
185402	8	8		
185403	7	7		
185404	4	4		
185405	8	7		
185406	1	1		
185407	5	6		
185408	4	4		
185409	6	6		
185410	16	15		
185411	0	0		
185412	5	6		
185501	17	17		
185502	9	14		
185503	6	7		
185504	21	22		
185505	19	19		
185506	21	22		
185507	30	31		
185508	25	26		
185509	30	30		
185510	9	13		
185511	21	26		
185512	26	28		Cycle 10 minimum
185601	30	31		
185602	19	29		
185603	30	31		
185604	17	18		
185605	31	31		
185606	22	23		
185607	20	21		
185608	17	19		

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
185609	21	22		
185610	22	22		
185611	15	18		
185612	17	21		
185701	4	6		
185702	14	14		
185703	18	24		
185704	13	15		
185705	0	0		
185706	6	11		
185707	6	6		
185708	9	10		
185709	0	0		
185710	0	0		
185711	0	0		
185712	0	0		
185801	1	1		
185802	0	0		
185803	0	0		
185804	1	0		Cycle 10 epoch of the last spotless day (*E*(LSD))
185805	0	0		
185806	0	0		
185807	0	0		
185808	0	0		
185809	0	0		
185810	0	0		
185811	0	0		
185812	0	0		
185901	0	0		
185902	0	0		
185903	0	0		
185904	0	0		
185905	0	0		
185906	0	0		
185907	0	0		
185908	0	0		
185909	0	0		
185910	0	0		
185911	0	0		
185912	0	0		
186001	0	0		
186002	0	0		Cycle 10 maximum
186003	0	0		
186004	0	0		
186005	0	0		
186006	0	0		
186007	0	0		
186008	0	0		
186009	0	0		
186010	0	0		
186011	0	0		
186012	0	0		

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
186101	0	0		
186102	0	0		
186103	0	0		
186104	0	0		
186105	0	0		
186106	0	0		
186107	0	0		
186108	0	0		
186109	0	0		
186110	2	0		Cycle 11 *E*(FSD)
186111	0	0		
186112	0	0		
186201	0	0		
186202	0	0		
186203	1	0		
186204	0	0		
186205	0	0		
186206	0	0		
186207	0	0		
186208	0	0		
186209	0	0		
186210	0	0		
186211	0	0		
186212	3	2		
186301	0	0		
186302	0	0		
186303	0	0		
186304	0	0		
186305	0	0		
186306	0	0		
186307	0	0		
186308	0	0		
186309	2	1		
186310	0	0		
186311	0	0		
186312	0	0		
186401	0	0		
186402	0	0		
186403	0	0		
186404	3	3		
186405	0	0		
186406	0	0		
186407	0	0		
186408	2	2		
186409	1	0		
186410	0	0		
186411	0	0		
186412	1	0		
186501	0	0		
186502	0	0		
186503	0	0		

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
186504	2	0		
186505	2	0		
186506	2	0		
186507	2	1		
186508	1	0		
186509	7	5		
186510	10	11		
186511	4	3		
186512	12	6		
186601	0	0		
186602	1	1		
186603	0	0		
186604	2	2		
186605	6	6		
186606	3	2		
186607	9	8		
186608	5	4		
186609	13	14		
186610	5	5		
186611	15	14		
186612	27	27		
186701	31	30		
186702	26	28		
186703	12	10		Cycle 11 minimum
186704	20	19		
186705	24	22		
186706	26	24		
186707	18	18		
186708	20	19		
186709	16	11		
186710	13	13		
186711	9	8		
186712	7	7		
186801	13	12		
186802	5	4		
186803	3	0		
186804	0	0		
186805	3	2		
186806	2	0		
186807	10	8		
186808	0	0		
186809	1	0		
186810	0	0		
186811	0	0		
186812	0	0		
186901	0	0		
186902	0	0		
186903	0	0		
186904	1	0		
186905	0	0		
186906	0	0		
186907	1	0		Cycle 11 *E*(LSD)

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
186908	0	0		
186909	0	0		
186910	0	0		
186911	0	0		
186912	0	0		
187001	0	0		
187002	0	0		
187003	0	0		
187004	0	0		
187005	0	0		
187006	0	0		
187007	0	0		
187008	0	0		Cycle 11 maximum
187009	0	0		
187010	0	0		
187011	0	0		
187012	0	0		
187101	0	0		
187102	0	0		
187103	0	0		
187104	0	0		
187105	0	0		
187106	0	0		
187107	0	0		
187108	0	0		
187109	0	0		
187110	0	0		
187111	0	0		
187112	0	0		
187201	0	0		
187202	0	0		
187203	0	0		
187204	0	0		
187205	0	0		
187206	0	0		
187207	0	0		
187208	0	0		
187209	0	0		
187210	0	0		
187211	0	0		
187212	0	0		
187301	0	0		
187302	0	0		
187303	0	0		
187304	0	0		
187305	4	0		Cycle 12 *E*(FSD)
187306	7	3		
187307	0	0		
187308	0	0		
187309	0	0		
187310	1	0		
187311	1	0		

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
187312	1	0		
187401	0	0		
187402	0	0		
187403	0	0		
187404	3	0		
187405	0	0	8	Start of RGO observations
187406	0	0	5	
187407	0	0	0	
187408	0	0	0	
187409	2	0	0	
187410	2	0	8	
187411	0	0	5	
187412	5	0	19	
187501	11	4	21	
187502	6	4	5	
187503	0	0	0	
187504	1	0	2	
187505	16	13	18	
187506	3	2	4	
187507	10	3	9	
187508	15	11	14	
187509	26	13	20	
187510	10	4	12	
187511	17	10	13	
187512	15	11	19	
187601	17	9	14	
187602	9	2	8	
187603	8	5	5	
187604	26	18	17	
187605	21	14	19	
187606	26	21	22	
187607	11	6	10	
187608	17	15	16	
187609	14	11	16	
187610	7	4	8	
187611	15	9	17	
187612	19	18	19	
187701	7	4	8	
187702	8	9	8	
187703	15	12	17	
187704	11	9	13	
187705	2	3	5	
187706	4	9	18	
187707	16	21	26	
187708	17	18	19	
187709	4	5	7	
187710	23	25	24	
187711	10	10	10	
187712	23	22	26	
187801	22	24	27	
187802	20	20	20	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
187803	15	16	20	
187804	29	30	29	
187805	22	23	26	
187806	18	16	19	
187807	30	30	30	
187808	31	30	31	
187809	18	17	18	
187810	28	27	28	
187811	18	18	18	
187812	29	30	29	Cycle 12 minimum
187901	26	27	29	
187902	26	26	28	
187903	31	31	31	
187904	17	17	21	
187905	24	24	27	
187906	20	22	26	
187907	10	15	20	
187908	15	16	24	
187909	12	13	19	
187910	12	12	14	
187911	10	10	13	
187912	12	16	21	
188001	7	3	8	
188002	6	6	7	
188003	5	5	9	
188004	1	1	10	
188005	3	3	7	
188006	0	0	3	
188007	5	3	7	
188008	0	0	4	
188009	0	0	0	
188010	0	0	0	
188011	3	0	5	
188012	1	0	2	
188101	1	0	2	
188102	0	0	0	
188103	0	0	1	
188104	0	0	0	
188105	0	0	0	
188106	0	0	0	
188107	0	0	0	
188108	3	0	3	
188109	0	0	0	
188110	0	0	1	
188111	0	0	0	
188112	1	0	1	
188201	0	0	3	
188202	0	0	0	
188203	0	0	0	
188204	0	0	0	
188205	0	0	0	
188206	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
188207	0	0	1	
188208	0	0	1	
188209	0	0	0	
188210	0	0	0	
188211	0	0	0	
188212	2	0	1	
188301	0	0	0	
188302	1	0	1	
188303	1	2	2	
188304	0	0	0	
188305	1	1	3	
188306	0	0	0	
188307	0	0	0	
188308	0	0	3	
188309	1	0	2	Cycle 12 *E*(LSD)
188310	0	0	0	
188311	0	0	0	
188312	0	0	1	Cycle 12 maximum
188401	0	0	0	
188402	0	0	0	
188403	0	0	0	
188404	0	0	0	
188405	0	0	0	
188406	0	0	0	
188407	0	0	0	
188408	0	0	0	
188409	0	0	0	
188410	0	0	0	
188411	0	0	1	
188412	0	0	0	
188501	1	0	2	Cycle 13 *E*(FSD)
188502	0	0	0	
188503	1	1	1	
188504	0	0	0	
188505	0	0	2	
188506	0	0	1	
188507	0	0	0	
188508	0	0	1	
188509	0	0	0	
188510	3	0	2	
188511	3	1	3	
188512	3	3	4	
188601	7	7	8	
188602	0	0	1	
188603	0	0	0	
188604	1	1	2	
188605	2	4	5	
188606	2	3	3	
188607	4	4	3	
188608	2	0	2	
188609	4	3	3	
188610	6	5	4	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
188611	27	29	23	
188612	7	7	9	
188701	8	10	11	
188702	10	10	10	
188703	15	13	14	
188704	11	11	9	
188705	5	4	5	
188706	0	0	1	
188707	4	3	4	
188708	11	8	9	
188709	12	14	16	
188710	11	13	13	
188711	13	14	13	
188712	4	7	6	
188801	7	4	5	
188802	12	14	15	
188803	12	15	14	
188804	11	13	13	
188805	17	18	18	
188806	10	13	13	
188807	16	20	19	
188808	20	8	11	
188809	6	5	6	
188810	21	25	27	
188811	7	9	9	
188812	11	14	13	
188901	28	28	29	
188902	15	15	16	
188903	15	16	16	
188904	17	18	18	
188905	24	24	24	
188906	17	15	15	
188907	11	11	13	
188908	8	6	6	
188909	13	14	15	
188910	20	23	19	
188911	27	30	30	
188912	17	17	15	
189001	16	16	15	
189002	25	27	26	
189003	17	19	18	Cycle 13 minimum
189004	20	20	20	
189005	16	15	15	
189006	23	21	24	
189007	10	10	11	
189008	14	10	15	
189009	2	1	4	
189010	9	8	12	
189011	12	12	12	
189012	7	7	5	
189101	11	10	13	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
189102	3	2	4	
189103	5	2	4	
189104	2	0	0	
189105	0	0	0	
189106	0	0	0	
189107	0	0	0	
189108	1	0	0	
189109	0	0	0	
189110	0	0	0	
189111	0	0	0	
189112	2	0	0	Cycle 13 *E*(LSD)
189201	0	0	0	
189202	0	0	2	
189203	0	0	2	
189204	0	0	0	
189205	0	0	0	
189206	0	0	0	
189207	0	0	0	
189208	0	0	0	
189209	0	0	0	
189210	0	0	0	
189211	0	0	0	
189212	0	0	0	
189301	0	0	0	
189302	0	0	0	
189303	0	0	1	
189304	0	0	0	
189305	0	0	0	
189306	0	0	1	
189307	0	0	0	
189308	0	0	0	
189309	0	0	0	
189310	0	0	0	
189311	0	0	0	
189312	0	0	1	
189401	0	0	1	Cycle 13 maximum
189402	0	0	0	
189403	0	0	0	
189404	0	0	0	
189405	0	0	0	
189406	0	0	0	
189407	0	0	0	
189408	0	0	0	
189409	0	0	0	
189410	0	0	0	
189411	0	0	0	
189412	0	0	0	
189501	0	0	1	
189502	0	0	0	
189503	0	0	0	
189504	0	0	0	
189505	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
189506	0	0	0	
189507	0	0	0	
189508	0	0	0	
189509	0	0	0	
189510	0	0	0	
189511	1	0	0	Cycle 14 *E*(FSD)
189512	0	0	0	
189601	0	0	0	
189602	0	0	1	
189603	0	0	0	
189604	3	3	3	
189605	1	0	2	
189606	0	0	0	
189607	0	0	0	
189608	2	1	3	
189609	0	0	0	
189610	1	1	1	
189611	0	0	0	
189612	0	0	0	
189701	0	0	0	
189702	0	0	1	
189803	1	1	1	
189704	3	2	2	
189705	6	6	7	
189706	6	7	7	
189707	0	0	7	
189708	0	0	0	
189709	0	0	0	
189710	7	7	8	
189711	8	9	6	
189712	1	1	1	
189801	1	1	0	
189802	3	3	3	
189803	5	6	6	
189804	9	9	6	
189805	0	0	1	
189806	1	0	6	
189807	11	11	13	
189808	2	2	4	
189809	0	0	0	
189810	0	0	0	
189811	0	0	0	
189812	7	8	12	
189901	2	2	1	
189902	10	11	12	
189903	4	8	6	
189904	1	0	1	
189905	7	8	11	
189906	2	2	4	
189907	9	9	11	
189908	24	24	26	
189909	11	14	18	
189910	16	16	15	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
189911	10	12	11	
189912	8	8	9	
190001	10	12	13	
190002	13	13	16	
190003	14	15	15	
190004	3	4	3	
190005	8	10	10	
190006	9	11	14	
190007	14	15	17	
190008	21	18	24	
190009	13	16	21	
190010	8	9	10	
190011	16	18	22	
190012	29	31	31	
190101	30	31	30	
190102	20	22	21	
190103	23	23	23	
190104	30	29	30	
190105	18	18	18	
190106	15	16	18	
190107	28	27	27	
190108	27	30	31	
190109	28	29	29	
190110	21	21	21	
190111	16	17	17	
190112	31	31	31	
190201	20	21	20	Cycle 14 minimum
190202	28	28	27	
190203	17	19	19	
190204	30	30	30	
190205	20	20	21	
190206	25	26	25	
190207	28	28	30	
190208	22	27	26	
190209	18	18	18	
190210	4	5	7	
190211	17	17	15	
190212	28	29	26	
190301	9	12	13	
190302	0	1	1	
190303	11	11	11	
190304	2	2	5	
190305	6	8	7	
190306	6	7	10	
190307	0	0	4	
190308	0	0	2	
190309	10	12	11	
190310	0	0	0	
190311	0	0	1	
190312	1	0	0	
190401	1	0	1	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
190402	0	0	1	
190403	0	0	1	
190404	0	0	0	
190405	0	0	0	
190406	0	0	0	
190407	0	0	0	
190408	0	0	0	
190409	0	0	0	
190410	0	0	0	
190411	0	0	0	
190412	0	0	0	
190501	1	0	1	
190502	0	0	0	
190503	0	0	0	
190504	0	0	0	
190505	1	0	1	
190506	0	0	0	
190507	1	0	2	Cycle 14 *E*(LSD)
190508	0	0	0	
190509	0	0	0	
190510	0	0	0	
190511	0	0	0	
190512	0	0	0	
190601	0	0	0	
190602	0	0	0	Cycle 14 maximum
190603	0	0	0	
190604	0	0	0	
190605	0	0	0	
190606	0	0	0	
190607	0	0	0	
190608	0	0	0	
190609	0	0	0	
190610	3	3	5	Cycle 15 *E*(FSD)
190611	0	0	0	
190612	0	0	1	
190701	0	0	0	
190702	0	0	0	
190703	0	0	0	
190704	0	0	0	
190705	0	0	0	
190706	0	0	0	
190707	0	0	0	
190708	0	0	0	
190709	0	0	0	
190710	0	0	0	
190711	0	0	1	
190712	0	0	0	
190801	0	0	1	
190802	0	0	0	
190803	1	0	1	
190804	0	0	0	
190805	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
190806	0	0	0	
190807	0	0	0	
190808	0	0	0	
190809	0	0	0	
190810	3	3	4	
190811	0	0	0	
190812	0	0	0	
190901	0	0	0	
190902	0	0	0	
190903	0	0	0	
190904	0	0	1	
190905	0	0	0	
190906	1	0	1	
190907	2	0	1	
190908	1	0	2	
190909	0	0	0	
190910	0	0	0	
190911	0	0	0	
190912	2	1	1	
191001	0	0	0	
191002	6	6	7	
191003	0	0	0	
191004	9	10	9	
191005	0	0	0	
191006	5	6	5	
191007	5	8	4	
191008	10	10	8	
191009	4	5	2	
191010	1	1	1	
191011	19	18	13	
191012	16	16	16	
191101	19	19	18	
191102	13	14	12	
191103	14	14	10	
191104	5	5	5	
191105	11	11	11	
191106	22	19	20	
191107	19	18	19	
191108	17	18	17	
191109	20	20	19	
191110	22	23	22	
191111	15	15	11	
191112	23	24	18	
191201	30	31	31	
191202	29	29	29	
191203	17	19	18	
191204	21	22	19	
191205	15	18	12	
191206	16	16	14	
191207	22	22	17	
191208	30	31	30	
191209	8	11	11	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
191210	21	23	21	
191211	27	30	26	
191212	17	17	17	
191301	22	23	20	
191302	19	19	19	
191303	29	29	29	
191304	27	27	27	
191305	31	31	31	
191306	30	30	30	
191307	25	24	25	
191308	30	31	31	Cycle 15 minimum
191309	27	27	27	
191310	21	21	21	
191311	27	29	28	
191312	23	23	23	
191401	24	23	24	
191402	21	22	20	
191403	21	21	22	
191404	1	1	1	
191405	19	19	18	
191406	15	15	15	
191407	14	13	8	
191408	15	15	15	
191409	9	9	8	
191410	12	11	10	
191411	2	0	2	
191412	0	0	0	
191501	0	0	0	
191502	1	0	0	
191503	0	0	0	
191504	2	0	1	
191505	9	9	5	
191506	0	0	0	
191507	0	0	0	
191508	0	0	0	
191509	0	0	0	
191510	0	0	0	
191511	0	0	0	
191512	0	0	0	
191601	0	0	0	
191602	0	0	0	
191603	0	0	0	
191604	0	0	0	
191605	0	0	0	
191606	0	0	1	
191607	0	0	0	
191608	3	3	2	
191609	0	0	0	
191610	1	1	1	Cycle 15 *E*(LSD)
191611	0	0	0	
191612	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
191701	0	0	0	
191702	0	0	0	
191703	0	0	0	
191704	0	0	0	
191705	0	0	0	
191706	0	0	0	
191707	0	0	0	
191708	0	0	0	Cycle 15 maximum
191709	0	0	0	
191710	0	0	0	
191711	0	0	0	
191712	0	0	0	
191801	0	0	0	
191802	0	0	0	
191803	0	0	0	
191804	0	0	0	
191805	0	0	0	
191806	0	0	0	
191807	0	0	0	
191808	0	0	0	
191809	0	0	0	
191810	0	0	0	
191811	0	0	1	
191812	0	0	0	
191901	0	0	0	
191902	0	0	0	
191903	0	0	0	
191904	0	0	0	
191905	0	0	0	
191906	0	0	0	
191907	0	0	0	
191908	0	0	0	
191909	0	0	0	
191910	0	0	0	
191911	0	0	0	
191912	0	0	0	
192001	0	0	0	
192002	0	0	0	
192003	0	0	0	
192004	1	1	1	Cycle 16 *E*(FSD)
192005	0	0	0	
192006	0	0	0	
192007	0	0	0	
192008	1	1	0	
192009	4	3	3	
192010	0	0	0	
192011	0	0	0	
192012	0	0	0	
192101	0	0	0	
192102	0	0	0	
192103	3	2	1	
192104	1	1	1	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
192105	6	4	3	
192106	1	0	0	
192107	0	0	0	
192108	5	3	4	
192109	4	4	4	
192110	7	7	6	
192111	9	9	8	
192112	10	6	4	
192201	10	10	9	
192202	4	0	0	
192203	3	2	0	
192204	13	13	9	
192205	14	13	13	
192206	14	11	13	
192207	13	12	11	
192208	17	16	15	
192209	12	12	12	
192210	14	13	11	
192211	9	7	6	
192212	11	10	10	
192301	21	24	20	
192302	23	22	20	
192303	20	21	19	
192304	13	12	10	
192305	19	19	16	
192306	14	13	12	
192307	20	20	17	
192308	29	28	24	Cycle 16 minimum
192309	4	4	4	
192310	3	3	2	
192311	9	9	8	
192312	24	22	19	
192401	29	30	26	
192402	22	22	20	
192403	25	24	23	
192404	17	16	14	
192405	5	5	4	
192406	0	0	0	
192407	1	0	0	
192408	0	0	0	
192409	0	0	0	
192410	0	0	0	
192411	8	8	8	
192412	9	8	3	
192501	17	17	8	
192502	1	3	3	
192503	6	5	5	
192504	0	0	0	
192505	0	0	0	
192506	2	1	1	
192507	1	0	0	
192508	1	2	2	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
192509	0	0	0	
192510	0	0	0	
192511	0	0	0	
192512	0	0	0	
192601	0	0	0	
192602	0	0	0	
192603	0	0	0	
192604	0	0	0	
192605	0	0	0	
192606	0	0	0	
192607	2	1	2	Cycle 16 *E*(LSD)
192608	0	0	0	
192609	0	0	0	
192610	0	0	0	
192611	0	0	0	
192612	0	0	0	
192701	0	0	0	
192702	0	0	0	
192703	0	0	0	
192704	0	0	0	
192705	0	0	0	
192706	0	0	0	
192707	0	0	0	
192708	0	0	0	
192709	0	0	0	
192710	0	0	0	
192711	0	0	0	
192712	0	0	0	
192801	0	0	0	
192802	0	0	0	
192803	0	0	0	
192804	0	0	0	Cycle 16 maximum
192805	0	0	0	
192806	0	0	0	
192807	0	0	0	
192808	0	0	0	
192809	0	0	0	
192810	0	0	0	
192811	0	0	0	
192812	0	0	0	
192901	0	0	0	
192902	0	0	0	
192903	0	0	0	
192904	0	0	0	
192905	0	0	0	
192906	0	0	0	
192907	0	0	0	
192908	0	0	0	
192909	0	0	0	
192910	0	0	0	
192911	0	0	0	
192912	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
193001	0	0	0	
193002	0	0	0	
193003	0	0	0	
193004	0	0	0	
193005	0	0	0	
193006	0	0	0	
193007	0	0	0	
193008	0	0	1	
193009	1	0	0	Cycle 17 *E*(FSD)
193010	0	0	0	
193011	1	1	1	
193012	1	0	2	
193101	4	5	4	
193102	1	1	1	
193103	0	0	0	
193104	0	0	0	
193105	0	0	0	
193106	11	10	11	
193107	3	2	2	
193108	10	9	7	
193109	0	0	0	
193110	5	4	6	
193111	7	6	8	
193112	2	2	3	
193201	7	5	4	
193202	11	10	10	
193203	8	8	7	
193204	12	10	7	
183205	5	5	5	
193206	1	1	1	
193207	10	10	8	
193208	14	12	12	
193209	16	16	16	
193210	6	6	6	
193211	12	13	10	
193212	6	5	5	
193301	12	12	12	
193302	12	12	12	
193303	9	9	9	
193304	22	23	21	
193305	21	21	19	
193306	14	14	14	
193307	24	24	22	
193308	30	30	29	
193309	15	16	14	Cycle 17 minimum
193310	23	24	23	
193311	28	29	29	
193312	30	30	30	
193401	21	21	21	
193402	8	7	8	
193403	18	20	16	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
193404	10	9	8	
193405	4	5	4	
193406	17	18	17	
193407	12	12	10	
193408	13	14	14	
193409	18	20	17	
193410	11	9	9	
193411	11	12	10	
193412	11	11	11	
193501	0	0	0	
193502	0	0	0	
193503	4	4	5	
193504	9	10	8	
193505	6	3	7	
193506	0	0	0	
193507	1	1	1	Cycle 17 *E*(LSD)
193508	0	0	0	
193509	0	0	0	
193510	0	0	0	
193511	0	0	0	
193512	0	0	0	
193601	0	0	0	
193602	0	0	0	
193603	0	0	0	
193604	0	0	0	
193605	0	0	0	
193606	0	0	0	
193607	0	0	0	
193608	0	0	0	
193609	0	0	0	
193610	0	0	0	
193611	0	0	0	
193612	0	0	0	
193701	0	0	0	
193702	0	0	0	
193703	0	0	0	
193704	0	0	0	Cycle 17 maximum
193705	0	0	0	
193706	0	0	0	
193707	0	0	0	
193708	0	0	0	
193709	0	0	0	
193710	0	0	0	
193711	0	0	0	
193712	0	0	0	
193801	0	0	0	
193802	0	0	0	
193803	0	0	0	
193804	0	0	0	
193805	0	0	0	
193806	0	0	0	
193807	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
193808	0	0	0	
193809	0	0	0	
193810	0	0	0	
193811	0	0	0	
193812	0	0	0	
193901	0	0	0	
193902	0	0	0	
193903	0	0	0	
193904	0	0	0	
193905	0	0	0	
193906	0	0	0	
193907	0	0	0	
193908	0	0	0	
193909	0	0	0	
193910	0	0	0	
193911	0	0	0	
193912	0	0	0	
194001	0	0	0	
194002	0	0	0	
194003	0	0	0	
194004	0	0	0	
194005	0	0	0	
194006	0	0	0	
194007	0	0	0	
194008	0	0	0	
194009	0	0	0	
194010	0	0	0	
194011	0	0	0	
194012	0	0	0	
194101	0	0	0	
194102	0	0	0	
194103	0	0	0	
194104	0	0	0	
194105	0	0	0	
194106	0	0	0	
194107	0	0	0	
194108	0	0	1	
194109	0	0	0	
194110	0	0	0	
194111	3	0	5	Cycle 18 *E*(FSD)
194112	2	2	2	
194201	1	1	2	
194202	0	0	0	
194203	1	1	2	
194204	0	0	0	
194205	2	2	1	
194206	6	6	3	
194207	5	3	3	
194208	2	0	0	
194209	1	0	0	
194210	3	3	4	
194211	3	3	2	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
194212	0	0	0	
194301	4	2	2	
194302	2	0	1	
194303	1	1	0	
194304	0	0	0	
194305	0	0	0	
194306	9	9	5	
194307	7	8	9	
194308	3	3	1	
194309	13	12	12	
194310	10	10	9	
194311	10	9	8	
194312	6	5	3	
194401	20	20	19	
194402	27	27	26	Cycle 18 minimum
194403	12	13	13	
194404	29	29	28	
194405	26	27	27	
194406	10	10	9	
194407	12	13	17	
194408	5	5	5	
194409	5	5	5	
194410	2	2	2	
194411	6	5	5	
194412	4	4	4	
194501	3	2	2	
194502	3	3	4	
194503	1	1	0	
194504	2	2	3	
194505	1	0	0	
194506	0	0	0	
194507	1	0	2	
194508	4	3	2	
194509	1	1	1	Cycle 18 *E*(LSD)
194510	0	0	0	
194511	0	0	0	
194512	0	0	0	
194601	0	0	0	
194602	0	0	0	
194603	0	0	0	
194604	0	0	0	
194605	0	0	0	
194606	0	0	0	
194607	0	0	0	
194608	0	0	0	
194609	0	0	0	
194610	0	0	0	
194611	0	0	0	
194612	0	0	0	
194701	0	0	0	
194702	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
194703	0	0	0	
194704	0	0	0	
194705	0	0	0	Cycle 18 maximum
194706	0	0	0	
194707	0	0	0	
194708	0	0	0	
194709	0	0	0	
194710	0	0	0	
194711	0	0	0	
194712	0	0	0	
194801	0	0	0	
194802	0	0	0	
194803	0	0	0	
194804	0	0	0	
194805	0	0	0	
194806	0	0	0	
194807	0	0	0	
194808	0	0	0	
194809	0	0	0	
194810	0	0	0	
194811	0	0	0	
194812	0	0	0	
194901	0	0	0	
194902	0	0	0	
194903	0	0	0	
194904	0	0	0	
194905	0	0	0	
194906	0	0	0	
194907	0	0	0	
194908	0	0	0	
194909	0	0	0	
194910	0	0	0	
194911	0	0	0	
194912	0	0	0	
195001	0	0	0	
195002	0	0	0	
195003	0	0	0	
195004	0	0	0	
195005	0	0	0	
195006	0	0	0	
195007	0	0	0	
195008	0	0	0	
195009	0	0	0	
195010	0	0	0	
195011	0	0	0	
195012	3	2	3	Cycle 19 *E*(FSD)
195101	0	0	0	
195102	0	0	0	
195103	0	0	0	
195104	0	0	0	
195105	0	0	0	
195106	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
195107	0	0	0	
195108	0	0	2	
195109	0	0	0	
195110	0	0	0	
195111	0	0	0	
195112	0	0	0	
195201	0	0	0	
195202	5	4	4	
195203	9	8	8	
195204	0	0	0	
195205	0	2	2	
195206	0	2	0	
195207	0	0	0	
195208	0	0	0	
195209	2	4	5	
195210	2	2	2	
195211	2	1	3	
195212	2	0	1	
195301	7	6	7	
195302	17	16	18	
195303	11	15	12	
195304	8	9	9	
195305	8	9	10	
195306	0	0	1	
195307	14	18	17	
195308	9	9	9	
195309	1	2	7	
195310	9	13	14	
195311	25	25	22	
195312	22	24	22	
195401	30	31	28	
195402	26	26	25	
195403	14	15	15	
195404	24	23	23	Cycle 19 minimum
195405	28	30	29	
195406	29	31	25	
195407	14	15	16	
195408	10	10	10	
195409	24	26	21	
195410	12	6	12	
195411	15	17	17	
195412	15	15	15	
195501	0	0	0	
195502	3	2	3	
195503	18	20	18	
195504	11	8	8	
195505	4	6	5	
195506	4	4	4	
195507	3	2	3	
195508	1	0	0	
195509	1	1	1	
195510	3	2	3	Cycle 19 *E*(LSD)
195511	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
195512	0	0	0	
195601	0	0	0	
195602	0	0	0	
195603	0	0	0	
195604	0	0	0	
195605	0	0	0	
195606	0	0	0	
195607	0	0	0	
195608	0	0	0	
195609	0	0	0	
195610	0	0	0	
195611	0	0	0	
195612	0	0	0	
195701	0	0	0	
195702	0	0	0	
195703	0	0	0	
195704	0	0	0	
195705	0	0	0	
195706	0	0	0	
195707	0	0	0	
195708	0	0	0	
195709	0	0	0	
195710	0	0	0	
195711	0	0	0	
195712	0	0	0	
195801	0	0	0	
195802	0	0	0	
195803	0	0	0	Cycle 19 maximum
195804	0	0	0	
195805	0	0	0	
195806	0	0	0	
195807	0	0	0	
195808	0	0	0	
195809	0	0	0	
195810	0	0	0	
195811	0	0	0	
195812	0	0	0	
195901	0	0	0	
195902	0	0	0	
195903	0	0	0	
195904	0	0	0	
195905	0	0	0	
195906	0	0	0	
195907	0	0	0	
195908	0	0	0	
195909	0	0	0	
195910	0	0	0	
195911	0	0	0	
195912	0	0	0	
196001	0	0	0	
196002	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
196003	0	0	0	
196004	0	0	0	
196005	0	0	0	
196006	0	0	0	
196007	0	0	0	
196008	0	0	0	
196009	0	0	0	
196010	0	0	0	
196011	0	0	0	
196012	0	0	0	
196101	0	0	0	
196102	0	0	0	
196103	0	0	0	
196104	0	0	0	
196105	0	0	0	
196106	0	0	0	
196107	0	0	0	
196108	0	0	0	
196109	0	0	0	
196110	0	0	0	
196111	3	3	3	Cycle 20 *E*(FSD)
196112	3	4	4	
196201	1	2	2	
196202	0	0	0	
196203	0	2	2	
196204	0	0	0	
196205	0	0	0	
196206	0	0	0	
196207	1	1	1	
196208	3	7	5	
196209	0	0	0	
196210	0	0	0	
196211	1	1	1	
196212	4	4	5	
196301	0	1	3	
196302	1	1	1	
196303	2	4	3	
196304	6	7	5	
196305	0	0	0	
196306	0	0	0	
196307	0	0	0	
196308	1	1	0	
196309	3	3	3	
196310	2	4	4	
196311	1	5	4	
196312	5	10	8	
196401	1	2	1	
196402	8	10	9	
196403	2	9	4	
196404	7	12	10	
196405	4	9	4	
196406	9	12	7	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
196407	20	22	20	
196408	11	14	12	
196409	18	19	17	
196410	15	19	11	Cycle 20 minimum
196411	10	16	10	
196412	6	5	5	
196501	2	3	1	
196502	4	5	6	
196503	4	4	6	
196504	13	14	13	
196505	8	7	6	
196506	4	7	8	
196507	10	11	9	
196508	9	13	10	
196509	3	3	3	
196510	3	5	3	
196511	7	9	9	
196512	3	3	2	
196601	4	6	5	
196602	0	0	0	
196603	2	3	2	
196604	0	0	0	
196605	1	2	2	
196606	0	0	0	
196607	0	0	0	
196608	1	1	2	Cycle 20 *E*(LSD)
196609	0	0	0	
196610	0	0	0	
196611	0	0	0	
196612	0	0	0	
196701	0	0	0	
196702	0	0	0	
196703	0	0	0	
196704	0	0	0	
196705	0	0	0	
196706	0	0	0	
196707	0	0	0	
196708	0	0	0	
196709	0	0	0	
196710	0	0	0	
196711	0	0	0	
196712	0	0	0	
196801	0	0	0	
196802	0	0	0	
196803	0	0	0	
196804	0	0	0	
196805	0	0	0	
196806	0	0	0	
196807	0	0	0	
196808	0	0	0	
196809	0	0	0	
196810	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
196811	0	0	0	Cycle 20 maximum
196812	0	0	0	
196901	0	0	0	
196902	0	0	0	
196903	0	0	0	
196904	0	0	0	
196905	0	0	0	
196906	0	0	0	
196907	0	0	0	
196908	0	0	0	
196909	0	0	0	
196910	0	0	0	
196911	0	0	0	
196912	0	0	0	
197001	0	0	0	
197002	0	0	0	
197003	0	0	0	
197004	0	0	0	
197005	0	0	0	
197006	0	0	0	
197007	0	0	0	
197008	0	0	0	
197009	0	0	0	
197010	0	0	0	
197011	0	0	0	
197012	0	0	0	
197101	0	0	0	
197102	0	0	0	
197103	0	0	0	
197104	0	0	0	
197105	0	0	0	
197106	0	0	0	
197107	0	0	0	
197108	0	0	0	
197109	0	0	0	
197110	0	0	0	
197111	0	0	0	
197112	0	0	0	
197201	0	0	0	
197202	0	0	0	
197203	0	0	0	
197204	0	0	0	
197205	0	0	0	
197206	0	0	0	
197207	0	0	0	
197208	0	0	0	
197209	0	0	0	
197210	0	0	1	
197211	0	0	0	
197212	0	0	0	
197301	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
197302	0	0	0	
197303	0	0	0	
197304	0	0	0	
197305	0	1	1	
197306	0	0	1	
197307	1	1	1	Cycle 21 *E*(FSD)
197308	6	4	5	
197309	2	1	0	
197310	5	5	5	
197311	6	6	6	
197312	7	6	6	
197401	7	5	4	
197402	2	1	3	
197403	1	0	1	
197404	0	0	0	
197405	5	3	5	
197406	0	0	0	
197407	0	0	0	
197408	0	0	0	
197409	1	0	1	
197410	0	0	1	
197411	0	0	1	
197412	4	7	7	
197501	2	4	4	
197502	9	9	10	
197503	9	11	10	
197504	18	21	18	
197505	13	17	16	
197506	9	7	8	
197507	0	0	0	
197508	0	0	1	
197509	7	5	5	
197510	9	10	10	
197511	6	6	7	
197512	13	12	13	
197601	16	14	15	
197602	18	20	20	
197603	5	5	5	
197604	2	2	2	
197605	6	6	6	
197606	7	7	8	Cycle 21 minimum
197607	24	23	23	
197608	0	0	0	
197609	3	5	5	
197610	3	4	4	
197611	15	15	13	
197612	6	7	5	End of RGO observations
197701	6	5	4	Start of SOON observations
197702	2	2	2	
197703	7	6	9	
197704	4	4	7	
197705	2	2	3	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
197706	0	0	0	
197707	4	4	5	Cycle 21 *E*(LSD)
197708	0	0	0	
197709	0	0	0	
197710	0	0	0	
197711	0	0	0	
197712	0	0	0	
197801	0	0	0	
197802	0	0	0	
197803	0	0	0	
197804	0	0	0	
197805	0	0	0	
197806	0	0	0	
197807	0	0	0	
197808	0	0	0	
197809	0	0	0	
197810	0	0	0	
197811	0	0	0	
197812	0	0	0	
197901	0	0	0	
197902	0	0	0	
197903	0	0	0	
197904	0	0	0	
197905	0	0	0	
197906	0	0	0	
197907	0	0	0	
197908	0	0	0	
197909	0	0	0	
197910	0	0	0	
197911	0	0	0	
197912	0	0	0	Cycle 21 maximum; SOON data dropout
198001	0	0	0	
198002	0	0	0	
198003	0	0	0	
198004	0	0	0	
198005	0	0	0	
198006	0	0	0	
198007	0	0	0	
198008	0	0	0	
198009	0	0	0	
198010	0	0	0	
198011	0	0	0	
198012	0	0	0	
198101	0	0	0	
198102	0	0	0	
198103	0	0	0	
198104	0	0	0	
198105	0	0	0	
198106	0	0	0	
198107	0	0	0	
198108	0	0	0	
198109	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
198110	0	0	0	
198111	0	0	0	
198112	0	0	0	
198201	0	0	0	
198202	0	0	0	
198203	0	0	0	
198204	0	0	0	
198205	0	0	0	
198206	0	0	0	
198207	0	0	0	
198208	0	0	0	
198209	0	0	0	
198210	0	0	0	
198211	0	0	0	
198212	0	0	0	
198301	0	0	0	
198302	0	0	0	
198303	0	0	0	
198304	0	0	0	
198305	0	0	0	
198306	0	0	0	
198307	0	0	0	
198308	0	0	0	
198309	0	0	0	
198310	0	0	0	
198311	4	6	6	Cycle 22 *E*(FSD)
198312	0	0	0	
198401	0	0	0	
198402	0	0	0	
198403	0	0	0	
198404	0	0	0	
198405	0	0	0	
198406	0	0	0	
198407	0	0	0	
198408	0	0	0	
198409	8	12	9	
198410	4	4	5	
198411	1	0	2	
198412	0	0	0	
198501	11	8	9	
198502	0	0	0	
198503	5	5	5	
198504	7	6	6	
198505	0	0	1	
198506	1	1	1	
198507	0	0	0	
198508	7	9	9	
198509	16	16	16	
198510	14	12	12	
198511	11	11	11	
198512	11	10	12	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
198601	24	22	22	
198602	4	5	5	
198603	6	9	9	
198604	5	4	4	
198605	9	8	8	
198606	26	27	26	
198607	5	4	5	
198608	8	8	8	
198609	18	18	18	Cycle 22 minimum
198610	2	2	2	
198611	5	7	8	
198612	17	18	18	
198701	7	7	7	
198702	19	16	16	
198703	2	1	2	
198704	0	0	0	
198705	0	0	0	
198706	7	7	9	
198707	9	10	10	Cycle 22 *E*(LSD)
198708	0	0	0	
198709	0	0	0	
198710	0	0	0	
198711	0	0	0	
198712	0	0	0	
198801	0	0	0	
198802	0	0	0	
198803	0	0	0	
198804	0	0	0	
198805	0	0	0	
198806	0	0	0	
198807	0	0	0	
198808	0	0	0	
198809	0	0	0	
198810	0	0	0	
198811	0	0	0	
198812	0	0	0	
198901	0	0	0	
198902	0	0	0	
198903	0	0	0	
198904	0	0	0	
198905	0	0	0	
198906	0	0	0	
198907	0	0	0	Cycle 22 maximum
198908	0	0	0	
198909	0	0	0	
198910	0	0	0	
198911	0	0	0	
198912	0	0	0	
199001	0	0	0	
199002	0	0	0	
199003	0	0	0	
199004	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
199005	0	0	0	
199006	0	0	0	
199007	0	0	0	
199008	0	0	0	
199009	0	0	0	
199010	0	0	0	
199011	0	0	0	
199012	0	0	0	
199101	0	0	0	
199102	0	0	0	
199103	0	0	0	
199104	0	0	0	
199105	0	0	0	
199106	0	0	0	
199107	0	0	0	
199108	0	0	0	
199109	0	0	0	
199110	0	0	0	
199111	0	0	0	
199112	0	0	0	
199201	0	0	0	
199202	0	0	0	
199203	0	0	0	
199204	0	0	0	
199205	0	0	0	
199206	0	0	0	
199207	0	0	0	
199208	0	0	0	
199209	0	0	0	
199210	0	0	0	
199211	0	0	0	
199212	0	0	0	
199301	0	0	0	
199302	0	0	0	
199303	0	0	0	
199304	0	0	0	
199305	0	0	0	
199306	0	0	0	
199307	0	0	0	
199308	0	0	0	
199309	0	2	4	
199310	0	0	0	
199311	0	0	0	
199312	0	0	0	
199401	0	0	0	
199402	0	0	0	
199403	0	0	0	
199404	5	5	5	Cycle 23 *E*(FSD)
199405	6	5	5	
199406	5	5	5	
199407	0	0	0	
199408	0	0	0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
199409	2	2	2	
199410	0	0	0	
199411	0	0	0	
199412	1	1	1	
199501	0	2	3	
199502	0	0	0	
199503	1	1	1	
199504	13	12	12	
199505	7	8	7	
199506	2	2	2	
199507	6	6	6	
199508	5	4	4	
199509	7	9	8	
199510	7	6	7	
199511	7	10	6	
199512	6	16	10	End of group sunspot number record
199601	13		10	
199602	15		15	
199603	9		12	
199604	17		14	
199605	17		17	Cycle 23 minimum
199606	5		5	
199607	14		12	
199608	0		0	
199609	25		23	
199610	28		27	
199611	8		8	
199612	12		12	
199701	13		12	
199702	13		15	
199703	12		12	
199704	4		3	
199705	3		2	
199706	2		1	
199707	11		9	
199708	2		2	
199709	0		0	
199710	1		1	
199711	0		0	
199712	0		0	
199801	3		3	Cycle 23 *E*(LSD)
199802	0		0	
199803	0		0	
199804	0		0	
199805	0		0	
199806	0		0	
199807	0		0	
199808	0		0	
199809	0		0	
199810	0		0	
199811	0		0	
199812	0		0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
199901	0		0	
199902	0		0	
199903	0		0	
199904	0		0	
199905	0		0	
199906	0		0	
199907	0		0	
199908	0		0	
199909	0		0	
199910	0		0	
199911	0		0	
199912	0		0	
200001	0		0	
200002	0		0	
200003	0		0	
200004	0		0	Cycle 23 maximum
200005	0		0	
200006	0		0	
200007	0		0	
200008	0		0	
200009	0		0	
200010	0		0	
200011	0		0	
200012	0		0	
200101	0		0	
200102	0		0	
200103	0		0	
200104	0		0	
200105	0		0	
200106	0		0	
200107	0		0	
200108	0		0	
200109	0		0	
200110	0		0	
200111	0		0	
200112	0		0	
200201	0		0	
200202	0		0	
200203	0		0	
200204	0		0	
200205	0		0	
200206	0		0	
200207	0		0	
200208	0		0	
200209	0		0	
200210	0		0	
200211	0		0	
200212	0		0	
200301	0		0	
200302	0		0	
200303	0		0	

Table 2. Listing of spotless days using ZI, group, and RGO/SOON observational data (Continued).

Date (yyyymm)	Z/I	G	RGO/SOON	Comments
200304	0		0	
200305	0		0	
200306	0		0	
200307	0		0	
200308	0		0	
200309	0		0	
200310	0		0	
200311	0		0	
200312	0		0	
200401	1		2	Cycle 24 *E*(FSD)
200402	0		0	
200403	0		0	
200404	0		0	
200405	0		0	
200406	0		0	
200407	0		0	
200408	0		0	
200409	0		0	
200410	2		2	
200411	0		0	
200412	0		0	
200501	0		0	
200502	0		0	
200503	1		0	
200504	0		1	
200505	0		0	
200506	1		1	
200507	3		5	
200508	0		0	
200509	0		0	
200510	5		8	
200511	2		2	
200512	0		0	
200601	3		5	
200602	14		19	
200603	10		7	
200604	0		0	
200605	4		4	

REFERENCES

1. Wilson, R.M.; and Hathaway, D.H.: "On the Relation Between Spotless Days and the Sunspot Cycle," NASA/TP—2005–213608, Marshall Space Flight Center, Alabama, January 2005.

2. Everitt, B.S.: *The Analysis of Contingency Tables*, John Wiley & Sons, Inc., New York, p. 38, 1977.

3. Hoyt, D.V.; and Schatten, K.H.: *The Role of the Sun in Climate Change*, Oxford University Press, New York, p. 34, 1997.

4. Hoyt, D.V.; and Schatten, K.H.: "Group Sunspot Numbers: A New Solar Activity Reconstruction" *Solar Phys*., Vol. 179, p. 189, 1998.

5. Hoyt, D.V.; and Schatten, K.H.: "Group Sunspot Numbers: A New Solar Activity Reconstruction" *Solar Phys*., Vol. 181, p. 491, 1998.

6. Hathaway, D.H.; Wilson, R.M.; and Reichmann, E.J.: "Group Sunspot Numbers: Sunspot Cycle Characteristics," *Solar Phys*., Vol. 211, p. 357, 2002.

7. Baranyi, T.; Győri, L.; Ludmány, A.; and Coffey, H. E.: "Comparison of Sunspot Area Data Bases," *Mon. Not. R. Astron. Soc*., Vol. 323, p. 223, 2001.

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 2006	Technical Publication

4. TITLE AND SUBTITLE

On the Relationship Between Spotless Days and the Sunspot Cycle: A Supplement

5. FUNDING NUMBERS

6. AUTHORS

Robert M. Wilson and David H. Hathaway

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

8. PERFORMING ORGANIZATION REPORT NUMBER

M–1170

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, DC 20546–0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

NASA/TP—2006–214601

11. SUPPLEMENTARY NOTES

Prepared by the Science and Exploration Research Office, Science and Mission Systems Office

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified-Unlimited
Subject Category 92
Availability: NASA CASI 301–621–0390

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This study provides supplemental material to an earlier study concerning the relationship between spotless days and the sunspot cycle.[1] Our previous study, Technical Publication (TP)—2005–213608 determined the timing and size of sunspot minimum and maximum for the new sunspot cycle, relative to the occurrence of the first spotless day during the declining phase of the old sunspot cycle and the last spotless day during the rising portion of the new cycle. Because the number of spotless days (NSD) rapidly increases as the cycle nears sunspot minimum and rapidly decreases thereafter, the size and timing of sunspot minimum and maximum might be more accurately determined using a higher threshold for comparison, rather than using the first and last spotless day occurrences. It is this aspect that is investigated more thoroughly in this TP.

14. SUBJECT TERMS

Sun, sunspot cycle, solar cycle, solar cycle prediction, spotless days

15. NUMBER OF PAGES

64

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

National Aeronautics and
Space Administration
IS20
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama
35812