Future Solar Activity Estimates for Use in Prediction of Space Environmental Effects on Spacecraft Orbital Lifetime and Performance

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Introduction

The main sources of uncertainty in spacecraft orbital lifetime prediction are estimated future solar radio flux and geomagnetic activity, modeled atmospheric density, and the ballistic factor. The major source of uncertainty in models estimating future atmospheric density at orbital altitude is the solar extreme ultraviolet heat input values. The observed 10.7-cm solar radio flux (not adjusted to 1 AU) is used as a proxy for this most significant input and is the basis for the development of most orbital altitude atmospheric density models in current use for spacecraft orbital lifetime and performance predictions**.**

Marshall Solar Activity Future Estimates (MSAFE) Model

Because no generally accepted physical solar model is available to accurately predict future solar activity, the NASA Marshall Space Flight Center (MSFC) developed a 13-month Zurich smoothed solar radio flux ($\overline{F}_{10.7}$) and geomagnetic ($\overline{A}_p$) index intermediate (months) and long-range (years) statistical estimation technique [Niehuss *et al.*, 1996; Vaughan *et al.*, 1999]. The technique is also applicable to the 13-month smoothed sunspot number ($\overline{R}$). The 13-month Zurich smoothing technique is a running average with a 13-month kernal size and the first and thirteenth months given half the weight of the others. This technique was developed by the Swiss Federal Observatory, Zurich, Switzerland [Waldmeier, 1961].

The primary reason for developing the MSFC Solar Activity Future Estimation (MSAFE) model, and for issuing intermediate and long-range solar radio flux and geomagnetic index future estimates, is the need for updated inputs to the upper atmosphere (thermosphere) density models used for spacecraft orbital lifetime predictions and performance requirement analyses [Dreher and Lyons, 1990]. Mission analysis and planning for future spacecraft launches and on-orbit operations require estimates of orbital lifetimes, altitudes, inclinations, and eccentricities as well as various space environment parameters important to selection of materials and parts and equipment design.

The MSFC Solar Activity Future Estimation (MSAFE) linear regression program is a modified McNish-Lincoln model [McNish and Lincoln, 1949; Boykin and Richards, 1966] based on the Lagrangian least-squares statistical technique of Holland and Vaughan [1984]. A detailed explanation of the MSAFE model, its computer program, and modifications that took place in 1995 and 1996 is given by Niehuss et al. [1996], copies of which are available on request. This model is built to provide the capability to provide monthly updates of future $\overline{F}_{10.7}$, $\overline{R}$, and $\overline{A}_p$ estimates with associated statistical confidence bounds, i.e. 95 Percentile, etc.

Observed Data

Generation of the information provided in this report begins each month with the acquisition of recently observed solar activity data. Table 1 (page 6) contains recent monthly mean observed 10.7 cm solar radio flux, sunspot number, and planetary geomagnetic index values. The information in this table is based upon data from the National Research Council of Canada for the Series C 10.7-cm solar radio flux ($F_{10.7}$) data, the Sunspot Index Data Center Brussels, Belgium for the monthly mean relative sunspot number (R), and the Institute for Geophysics in Gottingen, Germany for the monthly

mean geomagnetic index (A_p) data as received from the U. S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) via their National Geophysical Data Center (NGDC) site. When there is insufficient data at the NGDC site to provide information through the most recently completed month, preliminary values are calculated using daily values from the NOAA Space Environment Center (SEC) and the Sunspot Index Data Center site.

The inputs used by the MSAFE model computer program are databases comprising Lagrangian interpolated $\overline{F}_{10.7}$ (cycles 1 through 22 converted and observed), $\overline{R}$ (cycles 1 through 22 observed), and $\overline{A}_p$ (cycles 13 through 22 converted and observed) and the smoothed values for cycle 23. Table 2 (page 8) presents 13-month Zurich smoothed values for Cycle 22 and 23 of the observed 10.7 cm solar radio flux, sunspot number, and planetary geomagnetic index values assigned at the midpoint calculated from monthly values in Table 1 (page 6).

Future Estimates

Using these smoothed values as inputs, the MSAFE program estimates the intermediate-term (months) and long-term (years) behavior $\overline{F}_{10.7}$, $\overline{R}$, and $\overline{A}_p$ for up to 132 months into the future, initialized from the cycle 23 smooth sunspot number maximum. The cycle 23 smooth sunspot number maximum has been confirmed as April 2000. The established cycle 23 smooth 10.7 cm solar flux maximum ($\overline{F}_{10.7}$) for use in the MSAFE program has been re-initialized based on the confirmed cycle 23 smoothed sunspot number maximum ($\overline{R}$). The $\overline{A}_p$ input to the MSAFE program has been initialized at the smooth sunspot maximum ($\overline{R}$) for cycle 23.The results of the MSAFE model calculations (i.e. the output data) to the maximum of solar cycle 24 are reported in Tables 3, 4 and 5[1]. Table 3 (page 14) contains the statistical estimates of future $\overline{F}_{10.7}$ and $\overline{A}_p$ 5, 50, and 95 Percentile values for the balance of cycle 23 and cycle 24. Table 4 (page19) contains the statistical estimate of future $\overline{R}$ and $\overline{A}_p$ 5, 50, and 95 Percentile values for the balance of cycle 23 and cycle 24. Table 5[1] (page 22) contains the statistical estimates of 75 Percentile $\overline{F}_{10.7}$ and 95 Percentile $\overline{A}_p$ values for the balance of cycle 23 and cycle 24. The extended stastical characteristics of cycle 24 beyond the maximum are included to permit use of the information in long range spacecraft programs planning and analysis.

The computer program's input and output data are also depicted in graphical form. Figures 1 and 2 (page 28) illustrate the inputs and application of the MSAFE model to the 10.7-cm solar radio flux. Figure 1 is a plot of monthly mean and 13-month Zurich smoothed observed 10.7-cm solar radio flux for solar cycles 22 and 23. Figure 2 is a plot of the statistical estimates of future13-month Zurich smoothed 10.7-cm solar radio flux for solar cycles 23 and 24. Similarly, Figures 3 and 4 (page 29) demonstrate inputs and application of the MSAFE algorithm to sunspot number. Figure 3 is a plot of the monthly mean and 13-month Zurich smoothed observed sunspot number for solar cycles 22 and 23. Figure 4 is a plot of the statistical estimates of future13-month Zurich smoothed relative sunspot number for solar cycles 23 and 24. Figure 5[1] (page 30) is a plot of monthly mean and 13-month Zurich smoothed observed 10.7-cm solar radio flux for solar cycles 22 and 23. Figure 6 is a plot of the statistical estimates of future13-month Zurich smoothed 75 Percentile 10.7-cm solar radio flux for solar cycles 23 and 24.

It should be noted that the cycle 24 5, 50, and 95 Percentile values beyond the maximum are the statistical evaluation of the past 22 cycles and are not influenced by the MSAFE model's

[1] Table 5, Figure 5 and Figure 6 were added in June 2002 on the request of the NASA/JSC Vehicle Integration Performance and Resources (VIPeR) team.

performance. Cycle 24 values from the maximum are estimated using statistics for cycles 1 through 22 for $\overline{F}_{10.7}$ and $\overline{R}$, and statistics for cycles 13 through 22 are used for $\overline{A}_p$. The 50 percentile values in Tables 3 and 4 and in Figures 3 and 4, at and beyond maximum of cycle 24, are computed arithmetic means and are given with 95 Percentile and 5 Percentile values. Since the planetary geomagnetic data are only available for solar cycles 13 through 22 to produce the statistics, the small sample size requires that the 95 Percentile and 5 Percentile values for the $\overline{A}_p$ are only approximations. The mean solar cycle period of 11 years (132 months) is assumed for the period of cycle 23 to the maximum of cycle 24 based on the nominal solar cycle period from past records.

Applications

General. The observed and predicted solar activity information presented in this report is provided as input data for atmospheric and space environment models to ensure compatibility between calculations made for prediction of environmental effects on spacecraft orbital lifetime and performance, e.g. ambient density, ionospheric plasma density, cosmic ray flux, etc. The Marshall Engineering Thermosphere Model [Hickey, 1988a, 1988b], as well as the NASA/MSFC Global Reference Atmospheric Model-1999 Version [Justus et al., 1999], were developed on the basis of inputs of the daily 10.7-cm solar radio flux ($F_{10.7}$) and the 3-hourly planetary geomagnetic index (a_p) to compute atmospheric density. Some ionosphere models, such as the International Reference Ionosphere (IRI) and the Fully Analytical Ionospheric Model (FAIM), and newly emerging cosmic ray models utilize sunspot number (R) inputs. Therefore, the statistical estimates produced by the MSAFE model provide future 13-month smoothed values of the smoothed sunspot number ($\overline{R}$).

Changes of thermospheric and ionospheric density associated with short-term (days) variations in $F_{10.7}$, R, and A_p, required as inputs to the thermospheric and ionospheric models, are not represented by the 13-month Zurich smoothed statistical estimates of these parameters as provided by the MSAFE model and reported in this document. Future estimates of this dynamic component of the solar activity cannot be made with any acceptable degree of statistical confidence using existing techniques, so estimates from the MSAFE model represent the best information available for computing future orbital altitude atmospheric density and space environment parameters. Representative data sets, based on past $F_{10.7}$, R, and A_p values, may be utilized to compute the effects of the dynamic component on the ambient densities, etc. at orbital altitudes.

Design Requirements. Design requirements for solar activity and associated values of atmospheric space environment parameters are specified in the appropriate spacecraft and space vehicle project design requirements documentation. These documents should be consulted for this information. For spacecraft projects requiring minimum risk design for lifetime orbital altitude(s), re-boost activities, and control capability, the envelopes of 95 percentile estimates of future smoothed solar radio flux ($\overline{F}_{10.7}$) and geomagnetic index ($\overline{A}_p$) that are recommended. These estimates permit statistically conservative spacecraft design and mission planning. Critical project considerations such as orbital lifetime predictions should be based on the most current MSAFE model intermediate and long-range statistical estimates of future solar and geophysical data that are consistent with the critical project development and operational decision time points prior to the planned launch of the spacecraft.

Additional Information

Questions on the contents of this report may be addressed to Harold Euler (Harold.C.Euler@nasa.gov).

Customer Feedback
Marshall Space Flight Center's ISO 9000 process solicits customer feedback on all of our products. Please send an email to Dr. Rob Suggs (Rob.M.Suggs@nasa.gov) regarding the clarity and operational usefulness of this estimate.

References

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TABLE 1: RECENT MONTHLY MEAN SOLAR ACTIVITY VALUES				
Year	**Month**	**Solar Flux ($F_{10.7}$ (Series C))**	**Relative Sunspot Numbers (R)**	**Geomagnetic Index (A_P)**
2002	January	227.3	114.1	8
	February	205.0	107.4	10
	March	180.3	98.4	10
	April	189.8	120.7	17
	May	178.4	120.8	12
	June	148.7	88.3	7
	July	173.5	99.6	11
	August	183.9	116.4	14
	September	175.8	109.6	13
	October	167.0	97.5	25
	November	168.7	95.5	17
	December	158.6	80.8	13
2003	January	144.0	79.7	13
	February	124.5	46.0	17
	March	132.2	61.1	21
	April	126.3	60.0	20
	May	116.2	54.6	26
	June	129.3	77.4	24
	July	127.7	83.3	19
	August	122.1	72.7	23
	September	112.2	48.7	18
	October	151.3	65.5	35
	November	140.8	67.3	28
	December	115.0	46.5	16
2004	January	114.1	37.3	22
	February	107.0	45.8	13
	March	112.0	49.1	14
	April	101.2	39.3	11
	May	99.8	41.5	8
	June	97.4	43.2	8
	July	118.5	51.1	23
	August	110.0*	40.9	11*
	September	103.0*	27.7	10*
	October	105.9*	48.0	9*
	November	113.7*	43.5	26*
	December	95.0*	17.9	11*

Solar flux in units of 10^4 JANSKY (where one JANSKY equals 10^{-26} W m^{-2} Hz^{-1} Bandwidth)

* Preliminary Estimates

TABLE 1: RECENT MONTHLY MEAN SOLAR ACTIVITY VALUES				
Year	**Month**	**Solar Flux ($F_{10.7}$ (Series C))**	**Relative Sunspot Numbers (R)**	**Geomagnetic Index (A_P)**
2005	January	102.4*	31.3*	22.3*
	February	97.3*	29.1*	10.6*
	March	90.0*	24.8*	11.6*
	April			
	May			
	June			
	July			
	August			
	September			
	October			
	November			
	December			
2005	January			
	February			
	March			
	April			
	May			
	June			
	July			
	August			
	September			
	October			
	November			
	December			
2007	January			
	February			
	March			
	April			
	May			
	June			
	July			
	August			
	September			
	October			
	November			
	December			

* Preliminary Estimates

TABLE 2: 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
1987	January	76.3	17.6	10.0
	February	77.8	19.6	10.2
	March	79.4	22.1	10.4
	April	80.8	24.4	10.7
	May	82.4	26.5	10.9
	June	84.3	28.4	11.0
	July	86.7	31.2	11.2
	August	89.6	34.8	11.6
	September	92.7	39.0	12.0
	October	96.0	43.5	12.5
	November	98.7	46.7	13.1
	December	102.4	51.3	13.4
1988	January	107.8	58.2	13.5
	February	113.3	64.6	13.3
	March	118.8	71.3	12.9
	April	124.5	77.5	12.5
	May	129.8	83.8	12.3
	June	136.5	93.7	12.4
	July	146.2	104.3	12.8
	August	156.4	113.7	13.1
	September	165.0	121.2	14.2
	October	171.6	125.3	15.6
	November	177.5	130.4	16.1
	December	184.8	137.6	16.5
1989	January	190.2	142.0	16.7
	February	194.0	145.0	17.0
	March	199.7	149.7	17.6
	April	204.4	153.5	18.2
	May	209.3	156.9	18.8
	June	213.1	158.4	19.2
	July	212.6	158.5	19.1
	August	209.7	157.7	19.2
	September	207.2	156.6	18.8
	October	206.3	157.4	18.2
	November	206.1	157.5	18.4
	December	203.3	153.5	18.4

* Preliminary Estimates

TABLE 2 : 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
1990	January	200.3	150.6	18.6
	February	200.5	152.9	18.8
	March	198.7	152.0	18.6
	April	195.6	149.3	18.2
	May	192.4	147.0	17.6
	June	189.9	143.8	16.8
	July	190.4	140.6	16.2
	August	193.9	140.5	15.4
	September	198.3	142.1	15.0
	October	200.6	142.1	14.8
	November	201.2	141.7	14.4
	December	202.7	143.9	15.7
1991	January	205.5	147.6	17.4
	February	206.3	147.6	18.4
	March	205.9	146.6	19.1
	April	206.8	146.5	20.0
	May	207.1	145.5	21.7
	June	207.4	145.2	23.0
	July	207.7	146.3	23.6
	August	206.8	146.6	24.7
	September	203.9	144.9	25.0
	October	199.7	141.7	24.2
	November	195.4	138.1	24.1
	December	188.9	131.7	23.0
1992	January	181.8	123.7	21.1
	February	174.8	115.4	19.8
	March	168.5	108.2	19.4
	April	162.9	103.3	18.9
	May	158.9	100.3	17.5
	June	154.3	97.1	16.6
	July	146.7	90.7	16.6
	August	138.9	84.0	16.1
	September	133.8	79.5	15.9
	October	130.5	76.4	16.7
	November	128.2	74.4	16.6
	December	127.4	73.2	16.1

* Preliminary Estimates

TABLE 2: 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
1993	January	125.7	71.4	16.0
	February	123.1	69.3	15.9
	March	120.7	66.6	15.3
	April	118.1	63.6	14.9
	May	114.8	59.9	14.9
	June	111.3	56.1	15.0
	July	109.6	54.7	14.9
	August	107.6	52.3	15.4
	September	103.9	48.4	16.0
	October	100.4	44.9	16.4
	November	97.5	41.2	17.4
	December	94.8	38.4	18.1
1994	January	92.7	36.6	18.2
	February	91.2	34.8	18.1
	March	90.2	34.1	17.8
	April	89.3	33.7	18.0
	May	88.1	32.5	18.3
	June	86.7	30.8	18.2
	July	84.5	28.5	18.1
	August	82.5	26.8	17.5
	September	81.7	26.6	16.5
	October	81.4	26.5	15.5
	November	81.2	26.2	14.7
	December	81.0	25.6	14.3
1995	January	80.6	24.2	14.0
	February	80.2	23.0	14.0
	March	79.9	22.1	14.0
	April	79.2	20.6	13.8
	May	78.5	19.2	13.4
	June	77.7	18.2	13.0
	July	76.9	17.0	12.6
	August	76.0	15.4	12.2
	September	74.8	13.4	11.8
	October	73.8	12.1	11.5
	November	73.2	11.4	10.8
	December	72.8	10.8	10.0

* Preliminary Estimates

TABLE 2: 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
1996	January	72.4	10.4	9.7
	February	72.2	10.1	9.7
	March	72.1	9.7	9.8
	April	71.6	8.4	9.7
	May	71.4	8.0	9.5
	June	71.8	8.5	9.4
	July	72.0	8.4	9.3
	August	72.1	8.3	9.4
	September	72.3	8.4	9.3
	October	72.6	8.8	9.1
	November	73.0	9.8	9.1
	December	73.3	10.4	9.2
1997	January	73.4	10.5	9.3
	February	73.7	11.0	9.2
	March	75.1	13.5	8.9
	April	76.8	16.5	8.6
	May	78.4	18.3	8.6
	June	80.1	20.3	8.6
	July	81.8	22.6	8.5
	August	83.4	25.0	8.3
	September	85.7	28.3	8.4
	October	88.6	31.8	8.6
	November	91.3	35.0	9.0
	December	94.2	39.0	9.5
1998	January	97.5	43.7	9.9
	February	101.7	48.9	10.5
	March	105.8	53.4	11.1
	April	108.9	56.5	11.3
	May	112.0	59.4	11.6
	June	115.8	62.5	12.0
	July	120.0	65.5	12.2
	August	124.1	67.8	12.5
	September	126.8	69.5	12.7
	October	127.9	70.5	12.8
	November	130.0	73.0	12.5
	December	134.3	77.9	12.0

* Preliminary Estimates

TABLE 2: 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
1999	January	139.0	82.6	11.8
	February	142.6	84.6	11.6
	March	144.0	83.8	11.8
	April	145.8	85.5	12.2
	May	149.9	90.5	12.4
	June	152.9	93.1	12.4
	July	154.4	94.3	12.6
	August	156.3	97.5	12.9
	September	161.0	102.3	12.8
	October	167.2	107.8	12.7
	November	171.5	111.0	13.1
	December	173.4	111.1	13.8
2000	January	175.5	112.9	14.5
	February	176.8	116.8	15.0
	March	178.4	119.9	15.0
	April	180.5	120.8	14.9
	May	180.1	119.0	15.0
	June	179.7	118.7	15.0
	July	180.2	119.8	14.7
	August	179.5	118.6	14.2
	September	177.1	116.3	14.2
	October	175.6	114.5	15.0
	November	173.8	112.7	15.1
	December	172.1	112.0	14.7
2001	January	168.7	108.7	14.0
	February	165.6	104.0	13.3
	March	167.8	104.8	12.8
	April	171.6	107.5	12.5
	May	174.7	108.6	12.5
	June	178.7	109.8	12.4
	July	183.8	111.7	12.4
	August	188.7	113.6	13.0
	September	191.3	114.1	12.7
	October	191.9	114.0	12.1
	November	193.6	115.5	12.0
	December	193.8	114.6	12.4

* Preliminary Estimates

TABLE 2: 13-MONTH ZURICH SMOOTHED VALUES				
Year	**Month**	**+10.7-cm Solar Flux ($\bar{F}_{10.7}$)**	**++Sunspot Numbers ($\bar{R}$)**	**+++Geomagnetic Index ($\bar{A}_p$)**
2002	January	194.6	113.5	12.3
	February	197.2	114.6	13.1
	March	195.7	113.3	12.2
	April	191.5	110.5	12.5
	May	188.0	108.8	12.7
	June	182.9	106.2	12.9
	July	176.3	102.7	13.7
	August	169.5	98.7	14.2
	September	164.1	94.6	15.0
	October	159.4	90.5	15.6
	November	154.1	85.2	15.8
	December	150.7	82.0	17.1
2003	January	148.0	80.8	18.2
	February	143.6	78.3	18.9
	March	138.3	74.0	19.5
	April	135.0	70.1	20.1
	May	133.1	67.6	22.0
	June	130.2	65.0	21.5
	July	127.2	61.8	22.0
	August	125.2	60.0	22.2
	September	123.7	59.5	21.8
	October	121.8	58.2	21.1
	November	120.1	56.7	20.0
	December	118.0	54.8	18.6
2004	January	116.4*	52.0	18.1*
	February	115.5*	49.3	17.7*
	March	114.6*	47.1	16.9*
	April	112.3*	45.6	15.5*
	May	109.3*	43.8	14.3*
	June	107.3*	41.6	14.0*
	July	106.0*	40.2*	13.8*
	August	105.1*	39.2*	13.8*
	September	103.8*	37.5*	13.6*
	October			
	November			
	December			

NOTES:
+ computed and assigned at the mid-point from the National Research Council of Canada, Ottawa and Penticton Series C observed monthly values as received from the National Geophysical Data Center ftp site
++ computed and assigned at the mid-point from the Sunspot Index Data Center Brussels, Belgium observed monthly values as received from the National Geophysical Data Center ftp site
+++ computed and assigned at the mid-point from Institute for Geophysics in Gottingen, Germany observed monthly values as received from the National Geophysical Data Center ftp site

* Preliminary Estimates

TABLE 3 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2004.7500	OCT	103.7	101.4	98.3	14.4	13.7	13.0
2004.8333	NOV	103.0	99.0	93.2	15.2	13.6	12.2
2004.9167	DEC	102.6	97.0	90.3	15.6	13.5	11.4
2005.0000	JAN	101.1	95.2	88.5	15.8	13.3	10.6
2005.0833	FEB	101.8	93.7	85.7	16.0	13.2	10.0
2005.1667	MAR	102.2	92.4	83.9	15.9	13.1	9.9
2005.2500	APR	100.6	91.2	82.6	15.7	12.9	10.2
2005.3333	MAY	97.7	89.8	81.5	15.4	12.7	10.0
2005.4167	JUN	95.2	88.6	80.5	14.9	12.3	9.9
2005.5000	JUL	95.3	87.6	79.9	14.6	12.0	9.0
2005.5833	AUG	95.3	86.6	79.3	13.9	11.4	8.0
2005.6667	SEP	95.0	85.5	79.1	14.4	11.0	7.2
2005.7500	OCT	94.3	84.3	78.8	15.4	10.9	6.8
2005.8333	NOV	93.5	83.2	78.3	16.4	10.7	6.6
2005.9167	DEC	92.6	82.3	77.4	16.8	10.5	6.2
2006.0000	JAN	91.6	81.5	76.1	16.7	10.2	5.8
2006.0833	FEB	90.7	80.8	75.2	16.2	9.9	5.6
2006.1667	MAR	89.7	80.1	74.6	16.1	9.6	5.2
2006.2500	APR	88.2	79.4	73.9	16.5	9.5	5.2
2006.3333	MAY	86.5	78.6	73.1	16.6	9.5	5.2
2006.4167	JUN	84.2	77.6	72.0	16.6	9.5	5.4
2006.5000	JUL	81.7	76.7	71.5	16.4	9.6	5.7
2006.5833	AUG	80.2	75.9	71.3	15.6	9.6	6.0
2006.6667	SEP	79.9	75.3	71.1	14.7	9.6	6.2
2006.7500	OCT	79.7	74.6	70.5	14.1	9.7	6.4
2006.8333	NOV	80.2	74.0	70.1	14.6	9.8	6.5
2006.9167	DEC	80.8	73.6	70.0	15.0	9.9	6.6
2007.0000	JAN	81.8	73.2	69.8	15.6	10.1	6.8
2007.0833	FEB	83.3	72.8	69.5	15.9	10.3	7.3
2007.1667	MAR	84.6	72.6	68.6	16.3	10.3	7.3
2007.2500	APR	86.5	72.4	68.0	16.8	10.4	7.3
2007.3333	MAY	88.9	72.3	67.2	17.1	10.4	7.3
2007.4167	JUN	91.5	72.4	66.6	17.2	10.5	7.4
2007.5000	JUL	94.8	72.6	66.3	16.9	10.4	7.3
2007.5833	AUG	99.8	73.0	66.2	16.5	10.4	7.2
2007.6667	SEP	104.9	73.6	65.9	15.5	10.3	7.3
2007.7500	OCT	109.6	74.3	65.5	14.4	10.3	7.4
2007.8333	NOV	113.9	75.0	65.3	14.9	10.1	7.5
2007.9167	DEC	117.1	75.8	65.0	15.0	10.0	7.5
2008.0000	JAN	120.3	76.8	65.0	15.5	10.2	7.6
2008.0833	FEB	124.2	77.8	64.7	15.8	10.4	7.5
2008.1667	MAR	128.3	78.8	64.0	16.0	10.5	7.6
2008.2500	APR	132.7	80.0	64.1	16.3	10.6	7.6
2008.3333	MAY	138.3	81.6	64.6	16.5	10.6	7.8
2008.4167	JUN	144.4	83.7	65.1	16.6	10.8	8.2
2008.5000	JUL	149.3	85.8	65.9	16.8	11.1	8.5
2008.5833	AUG	153.2	88.2	67.0	17.1	11.4	8.8
2008.6667	SEP	156.1	90.8	68.5	17.3	11.8	8.7
2008.7500	OCT	158.4	93.4	70.1	16.9	12.2	8.7
2008.8333	NOV	161.1	96.2	71.2	15.9	12.2	8.7
2008.9167	DEC	164.9	99.1	72.5	15.2	12.0	8.5
2009.0000	JAN	169.5	102.1	74.2	14.9	12.1	8.4

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

TABLE 3 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2009.0833	FEB	173.9	105.2	75.9	14.6	12.1	8.1
2009.1667	MAR	179.9	109.0	78.3	14.3	12.1	7.7
2009.2500	APR	187.0	113.1	81.2	14.1	12.0	7.4
2009.3333	MAY	192.8	117.5	85.2	14.5	12.1	7.4
2009.4167	JUN	196.9	122.1	89.5	14.6	12.0	7.3
2009.5000	JUL	199.6	126.6	93.7	15.1	12.2	7.5
2009.5833	AUG	201.4	130.4	97.8	15.6	12.4	7.8
2009.6667	SEP	204.5	132.8	98.0	16.1	12.6	8.0
2009.7500	OCT	207.6	135.2	98.1	16.6	12.8	8.3
2009.8333	NOV	210.7	137.5	98.3	17.1	13.0	8.5
2009.9167	DEC	213.7	139.8	98.5	17.6	13.2	8.7
2010.0000	JAN	216.6	142.1	98.6	18.1	13.4	9.0
2010.0833	FEB	219.5	144.3	98.8	18.6	13.5	9.2
2010.1667	MAR	222.2	146.4	98.9	19.0	13.7	9.4
2010.2500	APR	224.8	148.4	99.0	19.4	13.8	9.6
2010.3333	MAY	227.3	150.4	99.2	19.8	14.0	9.8
2010.4167	JUN	229.7	152.2	99.3	20.2	14.1	10.0
2010.5000	JUL	231.8	153.8	99.4	20.5	14.3	10.1
2010.5833	AUG	233.8	155.3	99.5	20.8	14.4	10.3
2010.6667	SEP	235.5	156.7	99.6	21.1	14.5	10.4
2010.7500	OCT	237.1	157.9	99.7	21.3	14.6	10.5
2010.8333	NOV	238.4	158.9	99.7	21.5	14.6	10.6
2010.9167	DEC	239.4	159.7	99.8	21.7	14.7	10.7
2011.0000	JAN	240.2	160.3	99.8	21.8	14.7	10.7
2011.0833	FEB	240.7	160.6	99.9	21.9	14.8	10.8
2011.1667	MAR	240.8	160.8	99.9	21.9	14.8	10.8
2011.2500	APR	236.9	159.8	98.5	20.6	14.9	11.5
2011.3333	MAY	231.7	157.8	97.8	20.2	15.0	11.8
2011.4167	JUN	229.5	156.1	96.7	19.7	15.1	11.7
2011.5000	JUL	230.3	154.9	95.4	19.4	15.3	11.9
2011.5833	AUG	229.9	153.6	93.8	19.2	15.6	12.1
2011.6667	SEP	227.4	152.2	92.6	19.0	15.7	11.6
2011.7500	OCT	225.2	150.5	91.8	19.0	15.7	10.9
2011.8333	NOV	224.6	149.0	91.2	18.9	15.7	10.8
2011.9167	DEC	223.7	147.3	90.3	19.0	15.7	10.8
2012.0000	JAN	222.3	145.5	89.3	19.2	15.8	10.8
2012.0833	FEB	218.8	143.3	88.6	19.8	15.9	10.8
2012.1667	MAR	214.8	141.5	87.7	20.4	16.1	10.9
2012.2500	APR	211.5	140.1	86.2	21.4	16.3	10.8
2012.3333	MAY	206.4	139.0	85.4	21.9	16.5	10.7
2012.4167	JUN	201.5	137.8	84.9	21.6	16.6	10.6
2012.5000	JUL	196.4	136.3	84.0	21.3	16.4	10.3
2012.5833	AUG	191.5	135.1	82.7	21.8	16.5	10.3
2012.6667	SEP	192.5	133.9	81.3	23.1	16.7	10.4
2012.7500	OCT	195.5	132.6	80.4	23.3	16.9	10.9
2012.8333	NOV	196.9	131.0	79.8	22.7	17.0	11.7
2012.9167	DEC	197.5	129.4	79.1	22.6	17.0	11.8
2013.0000	JAN	198.8	128.0	78.4	22.7	16.9	11.9
2013.0833	FEB	201.3	126.8	77.5	23.2	17.1	12.0
2013.1667	MAR	202.0	125.7	76.5	23.9	17.3	12.1
2013.2500	APR	201.3	124.2	75.5	23.9	17.2	12.5
2013.3333	MAY	201.3	122.2	74.6	23.9	17.1	13.3

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

TABLE 3 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2013.4167	JUN	200.8	120.3	73.6	23.3	17.0	13.7
2013.5000	JUL	200.5	118.7	72.7	21.6	16.8	13.3
2013.5833	AUG	200.8	117.4	72.3	21.8	16.6	12.8
2013.6667	SEP	200.1	116.1	72.0	21.8	16.4	12.7
2013.7500	OCT	197.7	114.5	71.6	21.5	16.4	12.5
2013.8333	NOV	193.9	112.8	71.4	21.1	16.4	12.4
2013.9167	DEC	189.6	111.0	71.5	20.5	16.4	12.2
2014.0000	JAN	183.5	109.0	71.4	19.9	16.1	11.9
2014.0833	FEB	176.7	107.1	71.2	20.1	16.0	11.9
2014.1667	MAR	169.9	105.4	70.9	21.6	15.9	11.7
2014.2500	APR	163.7	104.0	70.7	23.2	15.8	11.7
2014.3333	MAY	158.4	102.7	70.5	24.0	15.8	11.5
2014.4167	JUN	154.5	101.3	70.7	25.1	15.7	11.3
2014.5000	JUL	150.7	100.1	71.1	25.8	15.7	11.3
2014.5833	AUG	144.6	98.8	71.2	25.0	15.6	10.8
2014.6667	SEP	137.6	97.6	71.4	25.0	15.6	10.3
2014.7500	OCT	132.6	96.5	71.2	24.1	15.7	10.7
2014.8333	NOV	129.3	95.2	70.7	22.2	15.7	10.8
2014.9167	DEC	127.0	94.0	70.3	21.4	15.6	10.8
2015.0000	JAN	126.3	93.2	70.0	21.7	15.8	11.0
2015.0833	FEB	125.2	92.5	69.6	22.4	16.0	11.2
2015.1667	MAR	123.2	91.5	69.2	22.6	16.0	11.2
2015.2500	APR	121.2	90.4	69.0	22.5	16.1	11.0
2015.3333	MAY	119.0	89.3	68.7	22.7	16.3	11.0
2015.4167	JUN	116.5	88.2	68.2	22.9	16.6	11.3
2015.5000	JUL	114.4	87.0	68.0	23.4	16.8	11.2
2015.5833	AUG	110.6	85.9	67.8	24.1	16.9	11.2
2015.6667	SEP	108.0	84.8	67.7	24.8	17.0	11.8
2015.7500	OCT	104.4	83.7	67.6	25.4	16.9	12.2
2015.8333	NOV	101.3	82.8	67.6	25.6	16.7	12.1
2015.9167	DEC	99.0	81.8	67.5	25.4	16.4	12.0
2016.0000	JAN	99.7	80.9	67.3	24.7	16.0	12.2
2016.0833	FEB	100.2	80.2	67.2	23.6	15.6	12.3
2016.1667	MAR	98.7	79.6	67.2	22.8	15.2	12.2
2016.2500	APR	95.8	78.9	67.2	22.4	14.9	11.8
2016.3333	MAY	93.0	78.4	67.2	21.9	14.6	11.2
2016.4167	JUN	91.3	77.9	67.1	21.6	14.2	10.7
2016.5000	JUL	91.5	77.3	67.1	20.9	13.8	10.0
2016.5833	AUG	91.4	76.8	67.0	20.0	13.4	9.4
2016.6667	SEP	90.9	76.2	67.0	18.7	13.1	9.0
2016.7500	OCT	90.4	75.7	67.0	18.2	12.8	8.5
2016.8333	NOV	89.7	75.2	67.0	18.7	12.6	8.0
2016.9167	DEC	88.8	74.9	67.1	18.7	12.5	7.8
2017.0000	JAN	88.1	74.6	67.3	18.4	12.4	7.4
2017.0833	FEB	87.2	74.2	67.4	18.4	12.2	7.0
2017.1667	MAR	85.9	73.9	67.5	18.8	12.1	6.6
2017.2500	APR	84.4	73.6	67.6	18.9	12.0	6.5
2017.3333	MAY	82.3	73.1	67.7	18.8	12.0	6.4
2017.4167	JUN	80.0	72.7	67.7	18.4	11.9	6.6
2017.5000	JUL	77.7	72.3	68.0	17.5	11.8	6.9
2017.5833	AUG	77.2	72.1	68.0	16.5	11.7	7.2
2017.6667	SEP	76.5	71.9	68.0	16.3	11.6	7.4

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

TABLE 3 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2017.7500	OCT	77.5	71.7	68.0	16.6	11.6	7.5
2017.8333	NOV	78.4	71.6	67.9	16.9	11.6	7.5
2017.9167	DEC	80.0	71.7	67.9	17.2	11.6	7.7
2018.0000	JAN	82.0	71.8	67.7	17.3	11.6	7.7
2018.0833	FEB	83.9	72.0	67.6	17.7	11.5	7.6
2018.1667	MAR	86.3	72.3	67.7	18.0	11.4	7.6
2018.2500	APR	89.2	72.6	67.6	18.2	11.4	7.6
2018.3333	MAY	92.3	73.0	67.6	18.1	11.3	7.6
2018.4167	JUN	95.7	73.4	67.7	17.8	11.2	7.5
2018.5000	JUL	101.0	74.1	67.9	17.3	11.1	7.5
2018.5833	AUG	106.6	75.0	68.1	16.3	11.0	7.5
2018.6667	SEP	111.8	76.1	68.5	15.5	10.9	7.5
2018.7500	OCT	116.5	77.2	68.6	16.1	10.8	7.7
2018.8333	NOV	120.1	78.2	68.8	16.3	10.8	7.7
2018.9167	DEC	123.6	79.5	69.1	16.6	10.9	7.8
2019.0000	JAN	127.8	80.8	69.3	16.7	11.0	7.7
2019.0833	FEB	132.4	82.2	69.6	16.8	11.1	7.7
2019.1667	MAR	137.2	83.7	70.2	17.1	11.1	7.8
2019.2500	APR	143.0	85.5	71.1	17.3	11.1	8.0
2019.3333	MAY	149.1	87.6	71.8	17.3	11.2	8.3
2019.4167	JUN	153.9	89.7	72.5	17.4	11.5	8.6
2019.5000	JUL	157.5	91.8	73.7	17.6	11.7	9.0
2019.5833	AUG	159.6	93.8	74.2	17.5	12.0	8.8
2019.6667	SEP	161.3	95.8	74.5	16.9	12.2	8.7
2019.7500	OCT	163.5	98.2	74.8	16.2	12.4	8.9
2019.8333	NOV	166.6	100.6	75.1	16.0	12.5	9.0
2019.9167	DEC	170.2	102.6	75.3	16.0	12.7	9.0
2020.0000	JAN	173.5	104.9	75.2	16.1	12.9	8.8
2020.0833	FEB	178.1	107.3	75.2	16.7	13.0	8.4
2020.1667	MAR	183.8	109.8	75.3	17.1	13.0	8.2
2020.2500	APR	187.7	112.2	75.7	17.5	13.1	8.2
2020.3333	MAY	189.8	114.8	76.1	18.2	13.2	8.1
2020.4167	JUN	190.7	117.3	76.6	18.5	13.2	7.9
2020.5000	JUL	191.4	119.6	77.5	18.5	13.1	7.8
2020.5833	AUG	194.0	121.7	78.3	18.7	13.1	7.9
2020.6667	SEP	196.9	123.6	78.6	19.0	13.2	8.1
2020.7500	OCT	199.5	125.3	79.6	18.6	13.3	8.6
2020.8333	NOV	203.8	127.2	80.8	17.8	13.3	9.2
2020.9167	DEC	209.3	129.1	82.2	18.1	13.4	9.6
2021.0000	JAN	212.7	131.4	84.1	18.9	13.5	10.1
2021.0833	FEB	214.5	133.8	85.4	19.1	13.6	10.1
2021.1667	MAR	218.5	136.2	86.3	19.5	13.9	10.3
2021.2500	APR	222.8	138.9	88.1	20.5	14.1	10.4
2021.3333	MAY	225.1	141.5	90.0	20.2	14.1	10.6
2021.4167	JUN	226.6	143.9	91.1	20.4	14.1	10.2
2021.5000	JUL	228.5	146.5	93.3	20.7	14.1	10.2
2021.5833	AUG	230.7	149.1	95.7	21.1	14.2	9.9
2021.6667	SEP	233.6	151.4	97.5	21.4	14.2	9.8
2021.7500	OCT	236.4	153.5	98.7	21.4	14.4	10.5
2021.8333	NOV	238.3	155.6	98.8	21.6	14.5	10.9
2021.9167	DEC	238.0	157.6	98.2	21.9	14.7	10.9
2022.0000	JAN	238.0	159.7	97.8	22.4	14.9	11.0

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

TABLE 3 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2022.0833	FEB	239.9	161.7	99.1	22.9	15.1	11.2

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

TABLE 4 ESTIMATES OF 13-MONTH SMOOTHED R* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		SUNSPOT NUMBER ($\bar{R}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2004.7500	OCT	38.2	36.1	33.7	14.4	13.7	13.0
2004.8333	NOV	38.3	34.6	28.9	15.2	13.6	12.2
2004.9167	DEC	38.7	33.1	24.5	15.6	13.5	11.4
2005.0000	JAN	37.4	31.6	22.1	15.8	13.3	10.6
2005.0833	FEB	35.8	30.4	21.2	16.0	13.2	10.0
2005.1667	MAR	37.2	29.4	19.3	15.9	13.1	9.9
2005.2500	APR	38.2	28.4	17.2	15.7	12.9	10.2
2005.3333	MAY	36.8	27.4	15.9	15.4	12.7	10.0
2005.4167	JUN	34.0	26.7	14.8	14.9	12.3	9.9
2005.5000	JUL	33.5	25.8	14.0	14.6	12.0	9.0
2005.5833	AUG	34.2	24.7	13.2	13.9	11.4	8.0
2005.6667	SEP	34.6	23.4	13.0	14.4	11.0	7.2
2005.7500	OCT	34.7	22.2	13.3	15.4	10.9	6.8
2005.8333	NOV	34.5	21.1	11.4	16.4	10.7	6.6
2005.9167	DEC	33.9	20.1	9.2	16.8	10.5	6.2
2006.0000	JAN	33.0	19.2	8.0	16.7	10.2	5.8
2006.0833	FEB	32.1	18.4	7.7	16.2	9.9	5.6
2006.1667	MAR	30.9	17.6	7.5	16.1	9.6	5.2
2006.2500	APR	29.2	16.6	7.2	16.5	9.5	5.2
2006.3333	MAY	27.2	15.7	7.4	16.6	9.5	5.2
2006.4167	JUN	24.7	14.6	7.0	16.6	9.5	5.4
2006.5000	JUL	21.7	13.5	5.6	16.4	9.6	5.7
2006.5833	AUG	18.4	12.5	4.8	15.6	9.6	6.0
2006.6667	SEP	16.8	11.9	4.9	14.7	9.6	6.2
2006.7500	OCT	17.8	11.5	4.4	14.1	9.7	6.4
2006.8333	NOV	17.0	11.0	3.2	14.6	9.8	6.5
2006.9167	DEC	15.7	10.5	2.4	15.0	9.9	6.6
2007.0000	JAN	15.5	10.1	2.0	15.6	10.1	6.8
2007.0833	FEB	15.8	10.0	1.9	15.9	10.3	7.3
2007.1667	MAR	16.4	9.9	1.3	16.3	10.3	7.3
2007.2500	APR	17.0	9.8	1.0	16.8	10.4	7.3
2007.3333	MAY	17.5	9.8	1.7	17.1	10.4	7.3
2007.4167	JUN	17.9	9.7	2.5	17.2	10.5	7.4
2007.5000	JUL	18.9	9.8	2.7	16.9	10.4	7.3
2007.5833	AUG	20.1	10.2	3.3	16.5	10.4	7.2
2007.6667	SEP	21.3	10.7	3.2	15.5	10.3	7.3
2007.7500	OCT	22.7	11.4	3.4	14.4	10.3	7.4
2007.8333	NOV	24.1	12.1	3.6	14.9	10.1	7.5
2007.9167	DEC	25.4	13.2	3.6	15.0	10.0	7.5
2008.0000	JAN	27.5	14.4	3.8	15.5	10.2	7.6
2008.0833	FEB	30.0	15.8	4.2	15.8	10.4	7.5
2008.1667	MAR	32.5	17.3	4.2	16.0	10.5	7.6
2008.2500	APR	35.0	18.9	4.9	16.3	10.6	7.6
2008.3333	MAY	39.0	21.0	5.7	16.5	10.6	7.8
2008.4167	JUN	44.5	23.3	6.3	16.6	10.8	8.2
2008.5000	JUL	48.7	25.7	7.1	16.8	11.1	8.5
2008.5833	AUG	52.3	28.1	7.9	17.1	11.4	8.8
2008.6667	SEP	55.3	30.6	8.7	17.3	11.8	8.7
2008.7500	OCT	62.8	33.3	9.8	16.9	12.2	8.7
2008.8333	NOV	70.9	36.4	10.1	15.9	12.2	8.7
2008.9167	DEC	78.4	39.3	10.6	15.2	12.0	8.5

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 4 ESTIMATES OF 13-MONTH SMOOTHED R* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		SUNSPOT NUMBER ($\bar{R}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2009.0000	JAN	84.9	42.3	11.4	14.9	12.1	8.4
2009.0833	FEB	92.1	45.4	12.1	14.6	12.1	8.1
2009.1667	MAR	100.5	48.5	13.2	14.3	12.1	7.7
2009.2500	APR	108.7	51.4	14.4	14.1	12.0	7.4
2009.3333	MAY	116.0	54.3	15.8	14.5	12.1	7.4
2009.4167	JUN	123.3	57.6	16.4	14.6	12.0	7.3
2009.5000	JUL	128.5	61.4	18.7	15.1	12.2	7.5
2009.5833	AUG	133.7	65.2	21.0	15.6	12.4	7.8
2009.6667	SEP	138.8	68.9	23.3	16.1	12.6	8.0
2009.7500	OCT	143.8	72.6	25.5	16.6	12.8	8.3
2009.8333	NOV	148.7	76.2	27.7	17.1	13.0	8.5
2009.9167	DEC	153.5	79.7	29.9	17.6	13.2	8.7
2010.0000	JAN	158.2	83.1	32.0	18.1	13.4	9.0
2010.0833	FEB	162.7	86.4	34.0	18.6	13.5	9.2
2010.1667	MAR	167.1	89.5	35.9	19.0	13.7	9.4
2010.2500	APR	171.2	92.5	37.8	19.4	13.8	9.6
2010.3333	MAY	175.1	95.4	39.5	19.8	14.0	9.8
2010.4167	JUN	178.7	98.0	41.1	20.2	14.1	10.0
2010.5000	JUL	182.0	100.4	42.6	20.5	14.3	10.1
2010.5833	AUG	185.0	102.6	44.0	20.8	14.4	10.3
2010.6667	SEP	187.8	104.6	45.2	21.1	14.5	10.4
2010.7500	OCT	190.1	106.3	46.2	21.3	14.6	10.5
2010.8333	NOV	192.1	107.8	47.1	21.5	14.6	10.6
2010.9167	DEC	193.7	108.9	47.8	21.7	14.7	10.7
2011.0000	JAN	194.8	109.8	48.3	21.8	14.7	10.7
2011.0833	FEB	195.5	110.3	48.7	21.9	14.8	10.8
2011.1667	MAR	195.8	110.5	48.8	21.9	14.8	10.8
2011.2500	APR	192.0	109.8	47.2	20.6	14.9	11.5
2011.3333	MAY	187.4	108.5	46.2	20.2	15.0	11.8
2011.4167	JUN	183.2	107.1	45.1	19.7	15.1	11.7
2011.5000	JUL	181.5	105.9	43.5	19.4	15.3	11.9
2011.5833	AUG	180.9	104.9	41.5	19.2	15.6	12.1
2011.6667	SEP	179.8	104.1	40.1	19.0	15.7	11.6
2011.7500	OCT	178.4	103.1	39.1	19.0	15.7	10.9
2011.8333	NOV	176.8	102.1	38.3	18.9	15.7	10.8
2011.9167	DEC	176.2	100.7	37.1	19.0	15.7	10.8
2012.0000	JAN	174.8	99.2	35.9	19.2	15.8	10.8
2012.0833	FEB	173.9	97.4	35.1	19.8	15.9	10.8
2012.1667	MAR	172.8	95.9	33.8	20.4	16.1	10.9
2012.2500	APR	169.3	94.3	32.0	21.4	16.3	10.8
2012.3333	MAY	165.6	93.1	30.8	21.9	16.5	10.7
2012.4167	JUN	162.5	92.1	30.4	21.6	16.6	10.6
2012.5000	JUL	158.1	91.3	29.1	21.3	16.4	10.3
2012.5833	AUG	156.8	90.4	27.2	21.8	16.5	10.3
2012.6667	SEP	156.5	88.9	25.5	23.1	16.7	10.4
2012.7500	OCT	152.5	87.0	24.2	23.3	16.9	10.9
2012.8333	NOV	149.4	85.0	23.3	22.7	17.0	11.7
2012.9167	DEC	150.9	83.1	22.3	22.6	17.0	11.8
2013.0000	JAN	150.5	81.4	21.1	22.7	16.9	11.9
2013.0833	FEB	148.5	79.8	19.8	23.2	17.1	12.0
2013.1667	MAR	146.8	78.6	18.3	23.9	17.3	12.1

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 4 ESTIMATES OF 13-MONTH SMOOTHED R* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		SUNSPOT NUMBER ($\bar{R}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2013.2500	APR	144.1	77.0	16.7	23.9	17.2	12.5
2013.3333	MAY	140.8	75.0	15.2	23.9	17.1	13.3
2013.4167	JUN	140.1	73.1	13.5	23.3	17.0	13.7
2013.5000	JUL	141.3	71.3	11.9	21.6	16.8	13.3
2013.5833	AUG	141.3	69.7	11.1	21.8	16.6	12.8
2013.6667	SEP	140.2	68.2	10.6	21.8	16.4	12.7
2013.7500	OCT	141.1	66.8	9.7	21.5	16.4	12.5
2013.8333	NOV	143.7	65.4	9.3	21.1	16.4	12.4
2013.9167	DEC	143.7	64.0	9.4	20.5	16.4	12.2
2014.0000	JAN	142.5	62.5	9.4	19.9	16.1	11.9
2014.0833	FEB	142.2	61.0	8.9	20.1	16.0	11.9
2014.1667	MAR	140.8	59.3	8.6	21.6	15.9	11.7
2014.2500	APR	139.4	57.6	8.2	23.2	15.8	11.7
2014.3333	MAY	139.2	56.0	8.0	24.0	15.8	11.5
2014.4167	JUN	139.0	54.3	8.5	25.1	15.7	11.3
2014.5000	JUL	137.9	52.9	9.1	25.8	15.7	11.3
2014.5833	AUG	135.6	51.7	9.5	25.0	15.6	10.8
2014.6667	SEP	132.6	50.4	9.7	25.0	15.6	10.3
2014.7500	OCT	127.7	49.2	9.3	24.1	15.7	10.7
2014.8333	NOV	120.8	47.4	8.5	22.2	15.7	10.8
2014.9167	DEC	113.1	45.5	7.7	21.4	15.6	10.8
2015.0000	JAN	106.0	43.9	7.0	21.7	15.8	11.0
2015.0833	FEB	100.7	42.6	6.2	22.4	16.0	11.2
2015.1667	MAR	96.9	41.0	5.5	22.6	16.0	11.2
2015.2500	APR	94.3	39.4	5.0	22.5	16.1	11.0
2015.3333	MAY	89.7	37.7	4.3	22.7	16.3	11.0
2015.4167	JUN	83.6	36.0	3.2	22.9	16.6	11.3
2015.5000	JUL	79.2	34.7	2.5	23.4	16.8	11.2
2015.5833	AUG	76.2	33.5	2.0	24.1	16.9	11.2
2015.6667	SEP	73.8	32.2	1.8	24.8	17.0	11.8
2015.7500	OCT	72.4	30.9	1.8	25.4	16.9	12.2
2015.8333	NOV	70.5	29.5	1.6	25.6	16.7	12.1
2015.9167	DEC	68.4	28.2	1.2	25.4	16.4	12.0
2016.0000	JAN	65.9	27.0	0.8	24.7	16.0	12.2
2016.0833	FEB	63.0	26.1	0.6	23.6	15.6	12.3
2016.1667	MAR	59.9	25.2	0.6	22.8	15.2	12.2
2016.2500	APR	56.2	24.4	0.6	22.4	14.9	11.8
2016.3333	MAY	54.1	23.8	0.5	21.9	14.6	11.2
2016.4167	JUN	52.2	23.0	0.3	21.6	14.2	10.7
2016.5000	JUL	48.8	22.0	0.2	20.9	13.8	10.0
2016.5833	AUG	45.5	20.9	0.1	20.0	13.4	9.4
2016.6667	SEP	42.3	19.9	0.0	18.7	13.1	9.0
2016.7500	OCT	39.5	18.9	0.0	18.2	12.8	8.5
2016.8333	NOV	37.6	18.1	0.0	18.7	12.6	8.0
2016.9167	DEC	36.4	17.3	0.3	18.7	12.5	7.8
2017.0000	JAN	35.3	16.7	0.8	18.4	12.4	7.4
2017.0833	FEB	34.3	15.9	1.0	18.4	12.2	7.0
2017.1667	MAR	33.1	15.1	1.3	18.8	12.1	6.6
2017.2500	APR	31.6	14.2	1.5	18.9	12.0	6.5
2017.3333	MAY	29.4	13.3	1.7	18.8	12.0	6.4
2017.4167	JUN	27.0	12.3	2.0	18.4	11.9	6.6

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 4 ESTIMATES OF 13-MONTH SMOOTHED R* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		SUNSPOT NUMBER ($\bar{R}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2017.5000	JUL	25.7	11.4	2.5	17.5	11.8	6.9
2017.5833	AUG	25.5	10.9	2.6	16.5	11.7	7.2
2017.6667	SEP	25.3	10.5	2.6	16.3	11.6	7.4
2017.7500	OCT	24.9	10.0	2.6	16.6	11.6	7.5
2017.8333	NOV	23.9	9.6	2.4	16.9	11.6	7.5
2017.9167	DEC	22.7	9.3	2.3	17.2	11.6	7.7
2018.0000	JAN	21.7	9.3	1.9	17.3	11.6	7.7
2018.0833	FEB	20.7	9.3	1.8	17.7	11.5	7.6
2018.1667	MAR	19.5	9.3	1.8	18.0	11.4	7.6
2018.2500	APR	18.5	9.5	1.8	18.2	11.4	7.6
2018.3333	MAY	17.7	9.5	1.7	18.1	11.3	7.6
2018.4167	JUN	18.3	9.6	1.7	17.8	11.2	7.5
2018.5000	JUL	19.6	10.0	2.4	17.3	11.1	7.5
2018.5833	AUG	21.2	10.7	3.0	16.3	11.0	7.5
2018.6667	SEP	23.0	11.5	3.8	15.5	10.9	7.5
2018.7500	OCT	24.7	12.3	4.0	16.1	10.8	7.7
2018.8333	NOV	26.1	13.4	4.5	16.3	10.8	7.7
2018.9167	DEC	28.3	14.8	5.2	16.6	10.9	7.8
2019.0000	JAN	31.0	16.2	5.8	16.7	11.0	7.7
2019.0833	FEB	33.9	17.8	6.2	16.8	11.1	7.7
2019.1667	MAR	37.7	19.6	7.4	17.1	11.1	7.8
2019.2500	APR	42.2	21.6	8.3	17.3	11.1	8.0
2019.3333	MAY	47.1	24.0	8.8	17.3	11.2	8.3
2019.4167	JUN	51.6	26.5	8.8	17.4	11.5	8.6
2019.5000	JUL	55.2	28.8	9.2	17.6	11.7	9.0
2019.5833	AUG	57.5	31.3	9.3	17.5	12.0	8.8
2019.6667	SEP	60.1	34.0	10.0	16.9	12.2	8.7
2019.7500	OCT	67.7	37.1	10.8	16.2	12.4	8.9
2019.8333	NOV	75.3	40.0	11.1	16.0	12.5	9.0
2019.9167	DEC	82.5	42.8	11.2	16.0	12.7	9.0
2020.0000	JAN	90.4	45.8	12.0	16.1	12.9	8.8
2020.0833	FEB	99.7	48.7	14.2	16.7	13.0	8.4
2020.1667	MAR	108.9	51.4	14.2	17.1	13.0	8.2
2020.2500	APR	117.1	54.1	14.4	17.5	13.1	8.2
2020.3333	MAY	125.4	57.2	14.8	18.2	13.2	8.1
2020.4167	JUN	134.0	60.6	15.4	18.5	13.2	7.9
2020.5000	JUL	140.4	63.7	17.0	18.5	13.1	7.8
2020.5833	AUG	143.1	66.2	18.8	18.7	13.1	7.9
2020.6667	SEP	145.6	68.4	19.7	19.0	13.2	8.1
2020.7500	OCT	149.2	70.7	21.5	18.6	13.3	8.6
2020.8333	NOV	152.7	73.2	24.0	17.8	13.3	9.2
2020.9167	DEC	157.6	75.7	26.5	18.1	13.4	9.6
2021.0000	JAN	162.1	78.4	29.1	18.9	13.5	10.1
2021.0833	FEB	164.3	81.0	30.9	19.1	13.6	10.1
2021.1667	MAR	168.2	83.9	32.1	19.5	13.9	10.3
2021.2500	APR	174.2	87.3	34.4	20.5	14.1	10.4
2021.3333	MAY	178.1	90.5	36.7	20.2	14.1	10.6
2021.4167	JUN	180.7	93.2	38.2	20.4	14.1	10.2
2021.5000	JUL	184.1	96.0	40.9	20.7	14.1	10.2
2021.5833	AUG	187.5	99.0	43.9	21.1	14.2	9.9
2021.6667	SEP	190.8	101.8	45.9	21.4	14.2	9.8

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 4 ESTIMATES OF 13-MONTH SMOOTHED R* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		SUNSPOT NUMBER ($\bar{R}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		95.0%	50%	5.0%	95.0%	50%	5.0%
2021.7500	OCT	193.0	104.2	47.3	21.4	14.4	10.5
2021.8333	NOV	194.0	106.2	47.5	21.6	14.5	10.9
2021.9167	DEC	193.3	108.2	46.7	21.9	14.7	10.9
2022.0000	JAN	192.9	110.4	46.3	22.4	14.9	11.0
2022.0833	FEB	195.2	112.7	47.8	22.9	15.1	11.2

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 5 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		75.0%	50%	5.0%	95.0%	50%	5.0%
2004.7500	OCT	101.9	101.4	98.3	14.4	13.7	13.0
2004.8333	NOV	100.1	99.0	93.2	15.2	13.6	12.2
2004.9167	DEC	98.5	97.0	90.3	15.6	13.5	11.4
2005.0000	JAN	96.5	95.2	88.5	15.8	13.3	10.6
2005.0833	FEB	95.6	93.7	85.7	16.0	13.2	10.0
2005.1667	MAR	94.7	92.4	83.9	15.9	13.1	9.9
2005.2500	APR	94.1	91.2	82.6	15.7	12.9	10.2
2005.3333	MAY	92.4	89.8	81.5	15.4	12.7	10.0
2005.4167	JUN	91.0	88.6	80.5	14.9	12.3	9.9
2005.5000	JUL	90.1	87.6	79.9	14.6	12.0	9.0
2005.5833	AUG	88.9	86.6	79.3	13.9	11.4	8.0
2005.6667	SEP	87.7	85.5	79.1	14.4	11.0	7.2
2005.7500	OCT	86.5	84.3	78.8	15.4	10.9	6.8
2005.8333	NOV	85.4	83.2	78.3	16.4	10.7	6.6
2005.9167	DEC	84.7	82.3	77.4	16.8	10.5	6.2
2006.0000	JAN	83.5	81.5	76.1	16.7	10.2	5.8
2006.0833	FEB	81.9	80.8	75.2	16.2	9.9	5.6
2006.1667	MAR	80.8	80.1	74.6	16.1	9.6	5.2
2006.2500	APR	80.0	79.4	73.9	16.5	9.5	5.2
2006.3333	MAY	79.3	78.6	73.1	16.6	9.5	5.2
2006.4167	JUN	78.6	77.6	72.0	16.6	9.5	5.4
2006.5000	JUL	78.1	76.7	71.5	16.4	9.6	5.7
2006.5833	AUG	77.3	75.9	71.3	15.6	9.6	6.0
2006.6667	SEP	76.9	75.3	71.1	14.7	9.6	6.2
2006.7500	OCT	75.8	74.6	70.5	14.1	9.7	6.4
2006.8333	NOV	74.9	74.0	70.1	14.6	9.8	6.5
2006.9167	DEC	74.6	73.6	70.0	15.0	9.9	6.6
2007.0000	JAN	74.4	73.2	69.8	15.6	10.1	6.8
2007.0833	FEB	74.1	72.8	69.5	15.9	10.3	7.3
2007.1667	MAR	74.0	72.6	68.6	16.3	10.3	7.3
2007.2500	APR	73.8	72.4	68.0	16.8	10.4	7.3
2007.3333	MAY	73.5	72.3	67.2	17.1	10.4	7.3
2007.4167	JUN	73.1	72.4	66.6	17.2	10.5	7.4
2007.5000	JUL	73.0	72.6	66.3	16.9	10.4	7.3
2007.5833	AUG	73.5	73.0	66.2	16.5	10.4	7.2
2007.6667	SEP	74.2	73.6	65.9	15.5	10.3	7.3
2007.7500	OCT	75.1	74.3	65.5	14.4	10.3	7.4
2007.8333	NOV	76.4	75.0	65.3	14.9	10.1	7.5
2007.9167	DEC	77.4	75.8	65.0	15.0	10.0	7.5
2008.0000	JAN	78.9	76.8	65.0	15.5	10.2	7.6
2008.0833	FEB	80.5	77.8	64.7	15.8	10.4	7.5
2008.1667	MAR	82.2	78.8	64.0	16.0	10.5	7.6
2008.2500	APR	84.7	80.0	64.1	16.3	10.6	7.6
2008.3333	MAY	87.2	81.6	64.6	16.5	10.6	7.8
2008.4167	JUN	89.3	83.7	65.1	16.6	10.8	8.2
2008.5000	JUL	91.2	85.8	65.9	16.8	11.1	8.5
2008.5833	AUG	92.9	88.2	67.0	17.1	11.4	8.8
2008.6667	SEP	94.5	90.8	68.5	17.3	11.8	8.7
2008.7500	OCT	97.7	93.4	70.1	16.9	12.2	8.7
2008.8333	NOV	101.0	96.2	71.2	15.9	12.2	8.7
2008.9167	DEC	104.3	99.1	72.5	15.2	12.0	8.5
2009.0000	JAN	107.5	102.1	74.2	14.9	12.1	8.4
2009.0833	FEB	111.4	105.2	75.9	14.6	12.1	8.1
2009.1667	MAR	116.1	109.0	78.3	14.3	12.1	7.7
2009.2500	APR	120.6	113.1	81.2	14.1	12.0	7.4
2009.3333	MAY	125.6	117.5	85.2	14.5	12.1	7.4

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 5 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		75.0%	50%	5.0%	95.0%	50%	5.0%
2009.4167	JUN	131.2	122.1	89.5	14.6	12.0	7.3
2009.5000	JUL	137.3	126.6	93.7	15.1	12.2	7.5
2009.5833	AUG	142.3	130.4	97.8	15.6	12.4	7.8
2009.6667	SEP	146.3	132.8	98.0	16.1	12.6	8.0
2009.7500	OCT	150.2	135.2	98.1	16.6	12.8	8.3
2009.8333	NOV	154.1	137.5	98.3	17.1	13.0	8.5
2009.9167	DEC	157.9	139.8	98.5	17.6	13.2	8.7
2010.0000	JAN	161.7	142.1	98.6	18.1	13.4	9.0
2010.0833	FEB	165.3	144.3	98.8	18.6	13.5	9.2
2010.1667	MAR	168.8	146.4	98.9	19.0	13.7	9.4
2010.2500	APR	172.1	148.4	99.0	19.4	13.8	9.6
2010.3333	MAY	175.3	150.4	99.2	19.8	14.0	9.8
2010.4167	JUN	178.3	152.2	99.3	20.2	14.1	10.0
2010.5000	JUL	181.0	153.8	99.4	20.5	14.3	10.1
2010.5833	AUG	183.5	155.3	99.5	20.8	14.4	10.3
2010.6667	SEP	185.8	156.7	99.6	21.1	14.5	10.4
2010.7500	OCT	187.7	157.9	99.7	21.3	14.6	10.5
2010.8333	NOV	189.4	158.9	99.7	21.5	14.6	10.6
2010.9167	DEC	190.7	159.7	99.8	21.7	14.7	10.7
2011.0000	JAN	191.7	160.3	99.8	21.8	14.7	10.7
2011.0833	FEB	192.3	160.6	99.9	21.9	14.8	10.8
2011.1667	MAR	192.5	160.8	99.9	21.9	14.8	10.8
2011.2500	APR	193.5	159.8	98.5	20.6	14.9	11.5
2011.3333	MAY	192.2	157.8	97.8	20.2	15.0	11.8
2011.4167	JUN	189.2	156.1	96.7	19.7	15.1	11.7
2011.5000	JUL	184.9	154.9	95.4	19.4	15.3	11.9
2011.5833	AUG	180.2	153.6	93.8	19.2	15.6	12.1
2011.6667	SEP	177.5	152.2	92.6	19.0	15.7	11.6
2011.7500	OCT	175.8	150.5	91.8	19.0	15.7	10.9
2011.8333	NOV	175.4	149.0	91.2	18.9	15.7	10.8
2011.9167	DEC	173.4	147.3	90.3	19.0	15.7	10.8
2012.0000	JAN	169.3	145.5	89.3	19.2	15.8	10.8
2012.0833	FEB	166.2	143.3	88.6	19.8	15.9	10.8
2012.1667	MAR	165.9	141.5	87.7	20.4	16.1	10.9
2012.2500	APR	163.7	140.1	86.2	21.4	16.3	10.8
2012.3333	MAY	160.6	139.0	85.4	21.9	16.5	10.7
2012.4167	JUN	159.8	137.8	84.9	21.6	16.6	10.6
2012.5000	JUL	158.8	136.3	84.0	21.3	16.4	10.3
2012.5833	AUG	156.3	135.1	82.7	21.8	16.5	10.3
2012.6667	SEP	153.6	133.9	81.3	23.1	16.7	10.4
2012.7500	OCT	152.4	132.6	80.4	23.3	16.9	10.9
2012.8333	NOV	151.6	131.0	79.8	22.7	17.0	11.7
2012.9167	DEC	151.1	129.4	79.1	22.6	17.0	11.8
2013.0000	JAN	149.3	128.0	78.4	22.7	16.9	11.9
2013.0833	FEB	146.2	126.8	77.5	23.2	17.1	12.0
2013.1667	MAR	144.8	125.7	76.5	23.9	17.3	12.1
2013.2500	APR	144.9	124.2	75.5	23.9	17.2	12.5
2013.3333	MAY	143.0	122.2	74.6	23.9	17.1	13.3
2013.4167	JUN	139.7	120.3	73.6	23.3	17.0	13.7
2013.5000	JUL	135.8	118.7	72.7	21.6	16.8	13.3
2013.5833	AUG	135.2	117.4	72.3	21.8	16.6	12.8
2013.6667	SEP	133.5	116.1	72.0	21.8	16.4	12.7
2013.7500	OCT	132.8	114.5	71.6	21.5	16.4	12.5
2013.8333	NOV	130.9	112.8	71.4	21.1	16.4	12.4
2013.9167	DEC	128.9	111.0	71.5	20.5	16.4	12.2
2014.0000	JAN	125.9	109.0	71.4	19.9	16.1	11.9
2014.0833	FEB	124.1	107.1	71.2	20.1	16.0	11.9
2014.1667	MAR	122.0	105.4	70.9	21.6	15.9	11.7

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 5 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		75.0%	50%	5.0%	95.0%	50%	5.0%
2014.2500	APR	119.0	104.0	70.7	23.2	15.8	11.7
2014.3333	MAY	118.6	102.7	70.5	24.0	15.8	11.5
2014.4167	JUN	116.9	101.3	70.7	25.1	15.7	11.3
2014.5000	JUL	115.8	100.1	71.1	25.8	15.7	11.3
2014.5833	AUG	115.7	98.8	71.2	25.0	15.6	10.8
2014.6667	SEP	116.6	97.6	71.4	25.0	15.6	10.3
2014.7500	OCT	114.5	96.5	71.2	24.1	15.7	10.7
2014.8333	NOV	111.2	95.2	70.7	22.2	15.7	10.8
2014.9167	DEC	109.4	94.0	70.3	21.4	15.6	10.8
2015.0000	JAN	108.2	93.2	70.0	21.7	15.8	11.0
2015.0833	FEB	106.7	92.5	69.6	22.4	16.0	11.2
2015.1667	MAR	104.8	91.5	69.2	22.6	16.0	11.2
2015.2500	APR	102.8	90.4	69.0	22.5	16.1	11.0
2015.3333	MAY	101.2	89.3	68.7	22.7	16.3	11.0
2015.4167	JUN	99.4	88.2	68.2	22.9	16.6	11.3
2015.5000	JUL	97.8	87.0	68.0	23.4	16.8	11.2
2015.5833	AUG	96.1	85.9	67.8	24.1	16.9	11.2
2015.6667	SEP	94.5	84.8	67.7	24.8	17.0	11.8
2015.7500	OCT	93.1	83.7	67.6	25.4	16.9	12.2
2015.8333	NOV	92.0	82.8	67.6	25.6	16.7	12.1
2015.9167	DEC	90.9	81.8	67.5	25.4	16.4	12.0
2016.0000	JAN	90.0	80.9	67.3	24.7	16.0	12.2
2016.0833	FEB	89.1	80.2	67.2	23.6	15.6	12.3
2016.1667	MAR	88.6	79.6	67.2	22.8	15.2	12.2
2016.2500	APR	87.4	78.9	67.2	22.4	14.9	11.8
2016.3333	MAY	86.0	78.4	67.2	21.9	14.6	11.2
2016.4167	JUN	85.4	77.9	67.1	21.6	14.2	10.7
2016.5000	JUL	84.6	77.3	67.1	20.9	13.8	10.0
2016.5833	AUG	83.4	76.8	67.0	20.0	13.4	9.4
2016.6667	SEP	82.1	76.2	67.0	18.7	13.1	9.0
2016.7500	OCT	81.0	75.7	67.0	18.2	12.8	8.5
2016.8333	NOV	80.1	75.2	67.0	18.7	12.6	8.0
2016.9167	DEC	78.9	74.9	67.1	18.7	12.5	7.8
2017.0000	JAN	78.2	74.6	67.3	18.4	12.4	7.4
2017.0833	FEB	77.7	74.2	67.4	18.4	12.2	7.0
2017.1667	MAR	76.9	73.9	67.5	18.8	12.1	6.6
2017.2500	APR	76.0	73.6	67.6	18.9	12.0	6.5
2017.3333	MAY	75.4	73.1	67.7	18.8	12.0	6.4
2017.4167	JUN	75.0	72.7	67.7	18.4	11.9	6.6
2017.5000	JUL	75.0	72.3	68.0	17.5	11.8	6.9
2017.5833	AUG	75.2	72.1	68.0	16.5	11.7	7.2
2017.6667	SEP	74.8	71.9	68.0	16.3	11.6	7.4
2017.7500	OCT	73.9	71.7	68.0	16.6	11.6	7.5
2017.8333	NOV	73.8	71.6	67.9	16.9	11.6	7.5
2017.9167	DEC	73.6	71.7	67.9	17.2	11.6	7.7
2018.0000	JAN	73.2	71.8	67.7	17.3	11.6	7.7
2018.0833	FEB	73.2	72.0	67.6	17.7	11.5	7.6
2018.1667	MAR	73.6	72.3	67.7	18.0	11.4	7.6
2018.2500	APR	73.6	72.6	67.6	18.2	11.4	7.6
2018.3333	MAY	74.0	73.0	67.6	18.1	11.3	7.6
2018.4167	JUN	74.0	73.4	67.7	17.8	11.2	7.5
2018.5000	JUL	74.6	74.1	67.9	17.3	11.1	7.5
2018.5833	AUG	75.6	75.0	68.1	16.3	11.0	7.5
2018.6667	SEP	77.0	76.1	68.5	15.5	10.9	7.5
2018.7500	OCT	78.5	77.2	68.6	16.1	10.8	7.7
2018.8333	NOV	80.3	78.2	68.8	16.3	10.8	7.7
2018.9167	DEC	82.4	79.5	69.1	16.6	10.9	7.8
2019.0000	JAN	84.0	80.8	69.3	16.7	11.0	7.7

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

TABLE 5 ESTIMATES OF 13-MONTH SMOOTHED $F_{10.7}$* AND A_p FOR BALANCE OF CYCLE 23 AND CYCLE 24

TIME		10.7-CM SOLAR FLUX ($\bar{F}_{10.7}$) PERCENTILE			GEOMAGNETIC INDEX ($\bar{A}_p$) PERCENTILE		
		75.0%	50%	5.0%	95.0%	50%	5.0%
2019.0833	FEB	85.2	82.2	69.6	16.8	11.1	7.7
2019.1667	MAR	86.5	83.7	70.2	17.1	11.1	7.8
2019.2500	APR	88.7	85.5	71.1	17.3	11.1	8.0
2019.3333	MAY	92.6	87.6	71.8	17.3	11.2	8.3
2019.4167	JUN	95.0	89.7	72.5	17.4	11.5	8.6
2019.5000	JUL	97.1	91.8	73.7	17.6	11.7	9.0
2019.5833	AUG	99.1	93.8	74.2	17.5	12.0	8.8
2019.6667	SEP	101.7	95.8	74.5	16.9	12.2	8.7
2019.7500	OCT	104.4	98.2	74.8	16.2	12.4	8.9
2019.8333	NOV	106.8	100.6	75.1	16.0	12.5	9.0
2019.9167	DEC	108.5	102.6	75.3	16.0	12.7	9.0
2020.0000	JAN	111.1	104.9	75.2	16.1	12.9	8.8
2020.0833	FEB	114.6	107.3	75.2	16.7	13.0	8.4
2020.1667	MAR	116.0	109.8	75.3	17.1	13.0	8.2
2020.2500	APR	117.8	112.2	75.7	17.5	13.1	8.2
2020.3333	MAY	120.4	114.8	76.1	18.2	13.2	8.1
2020.4167	JUN	123.7	117.3	76.6	18.5	13.2	7.9
2020.5000	JUL	126.4	119.6	77.5	18.5	13.1	7.8
2020.5833	AUG	129.8	121.7	78.3	18.7	13.1	7.9
2020.6667	SEP	133.4	123.6	78.6	19.0	13.2	8.1
2020.7500	OCT	137.0	125.3	79.6	18.6	13.3	8.6
2020.8333	NOV	141.7	127.2	80.8	17.8	13.3	9.2
2020.9167	DEC	147.0	129.1	82.2	18.1	13.4	9.6
2021.0000	JAN	150.9	131.4	84.1	18.9	13.5	10.1
2021.0833	FEB	152.9	133.8	85.4	19.1	13.6	10.1
2021.1667	MAR	155.0	136.2	86.3	19.5	13.9	10.3
2021.2500	APR	159.0	138.9	88.1	20.5	14.1	10.4
2021.3333	MAY	163.4	141.5	90.0	20.2	14.1	10.6
2021.4167	JUN	167.6	143.9	91.1	20.4	14.1	10.2
2021.5000	JUL	172.9	146.5	93.3	20.7	14.1	10.2
2021.5833	AUG	178.7	149.1	95.7	21.1	14.2	9.9
2021.6667	SEP	181.8	151.4	97.5	21.4	14.2	9.8
2021.7500	OCT	184.2	153.5	98.7	21.4	14.4	10.5
2021.8333	NOV	187.0	155.6	98.8	21.6	14.5	10.9
2021.9167	DEC	189.7	157.6	98.2	21.9	14.7	10.9
2022.0000	JAN	191.8	159.7	97.8	22.4	14.9	11.0
2022.0833	FEB	192.7	161.7	99.1	22.9	15.1	11.2

* Program Initialized from established Cycle 23 Smoothed Sunspot maximum

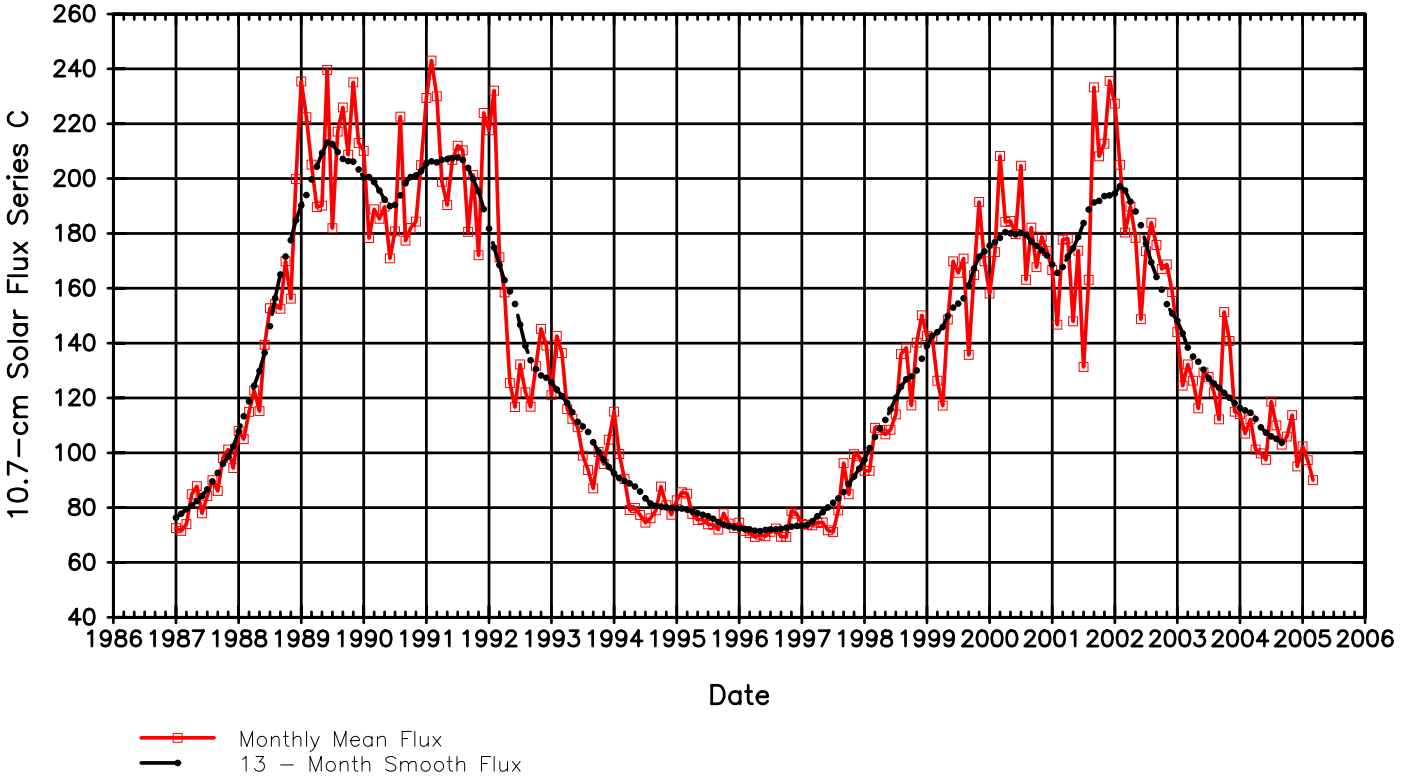

Figure 1. Plot of Recent Monthly Mean and 13-Month Smoothed Solar Flux

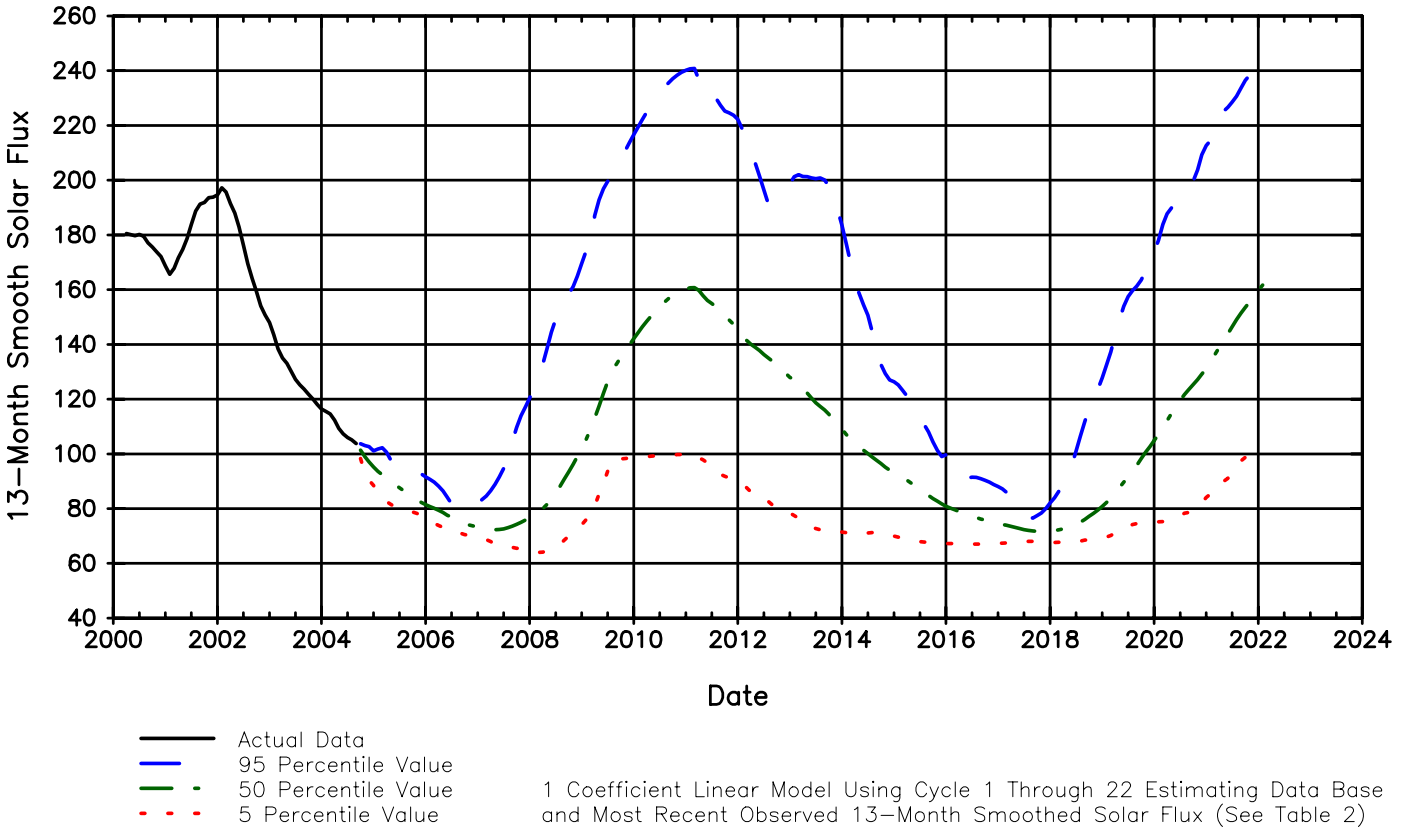

Figure 2. Estimate of 13-Month Smoothed Solar Flux For Cycle 23* and Cycle 24

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

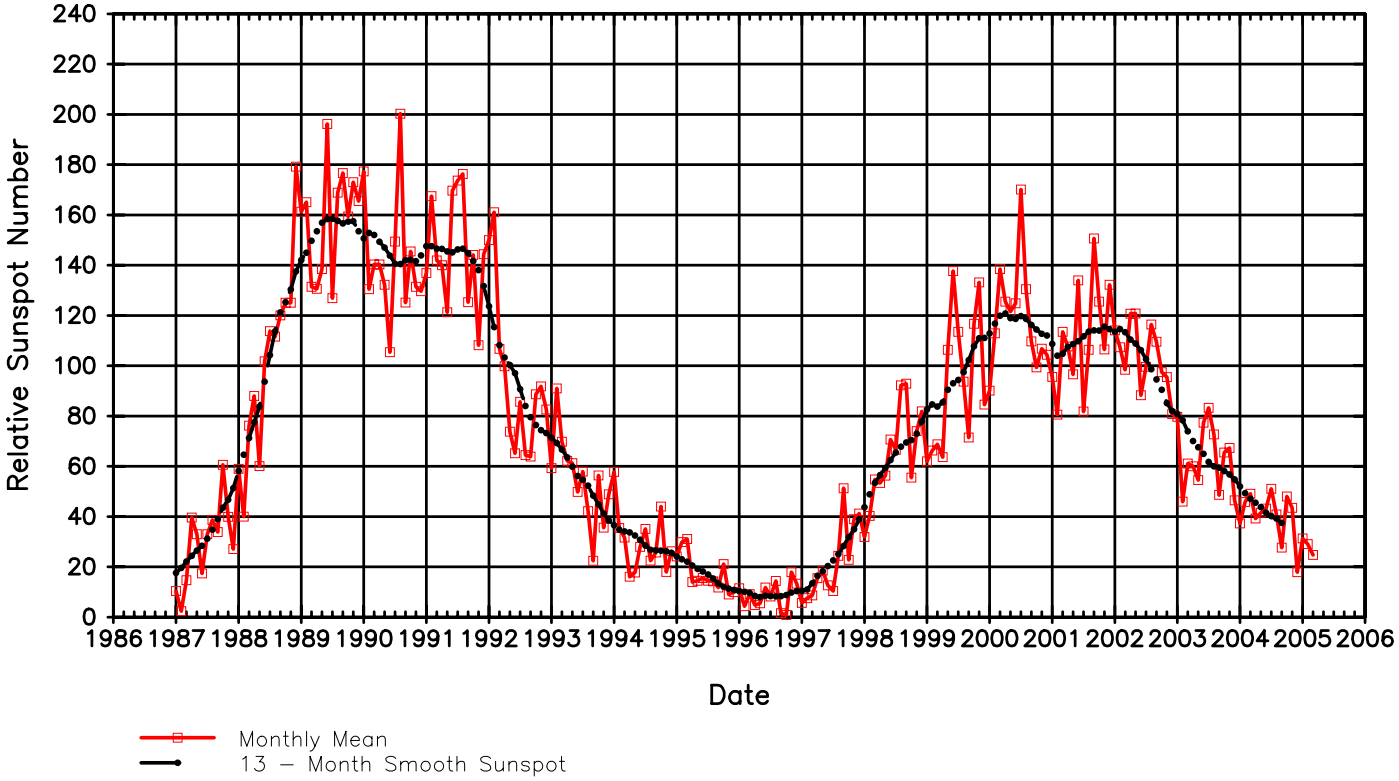

Figure 3. Plot of Recent Monthly Mean and 13-Month Smoothed Relative Sunspot Number

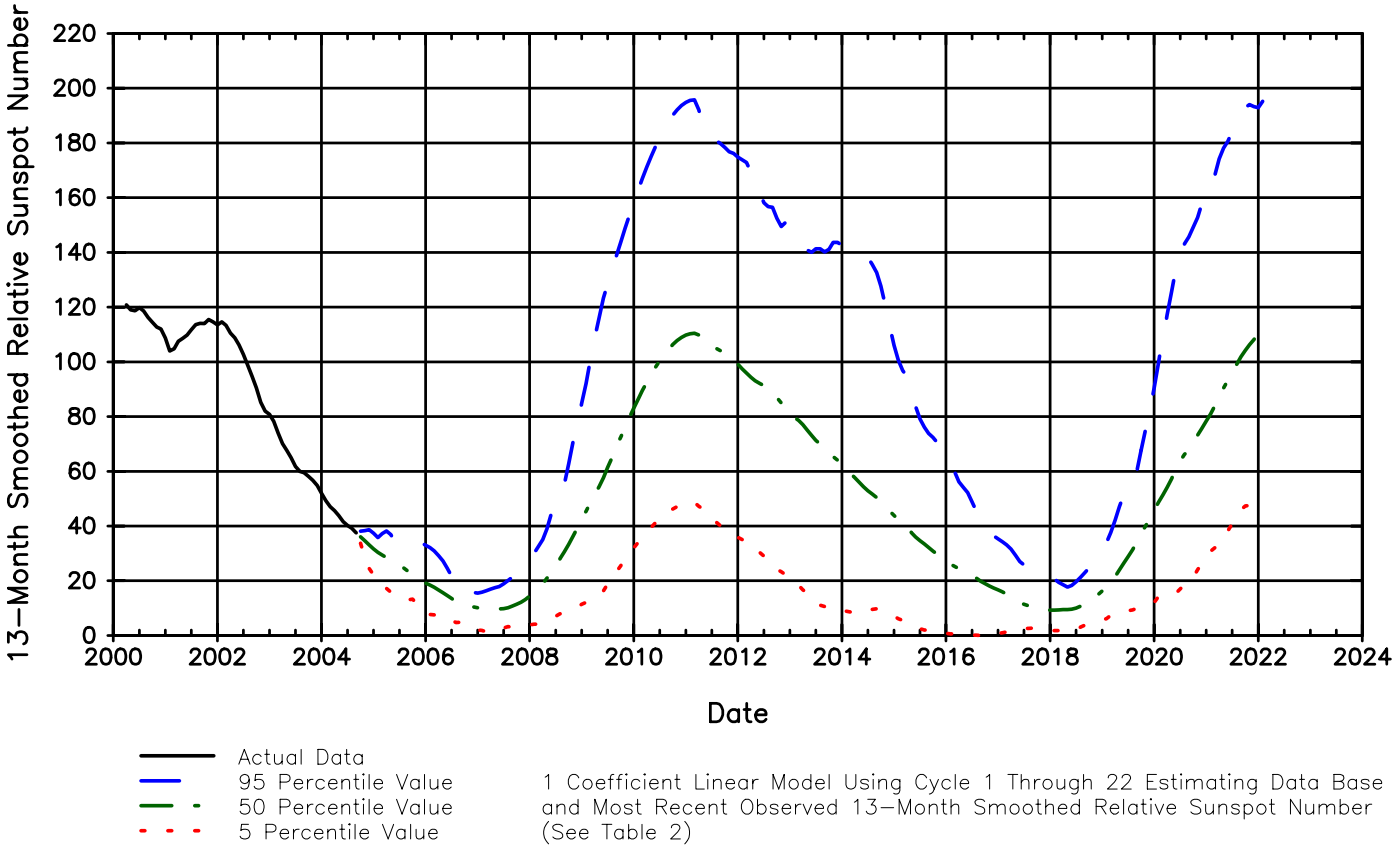

Figure 4. Estimate of 13-Month Smoothed Sunspot Number For Cycle 23* and Cycle 24

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum

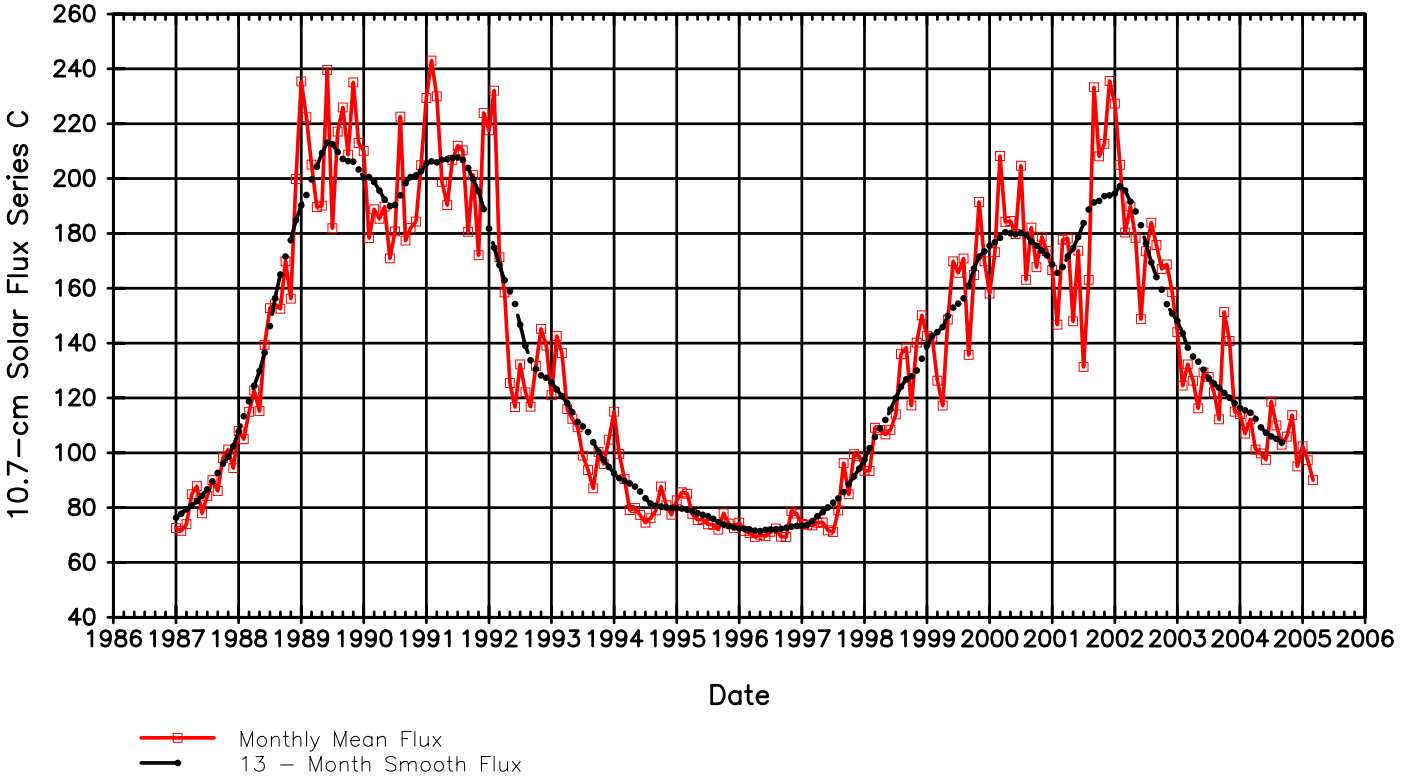

Figure 5. Plot of Recent Monthly Mean and 13-Month Smoothed Solar Flux

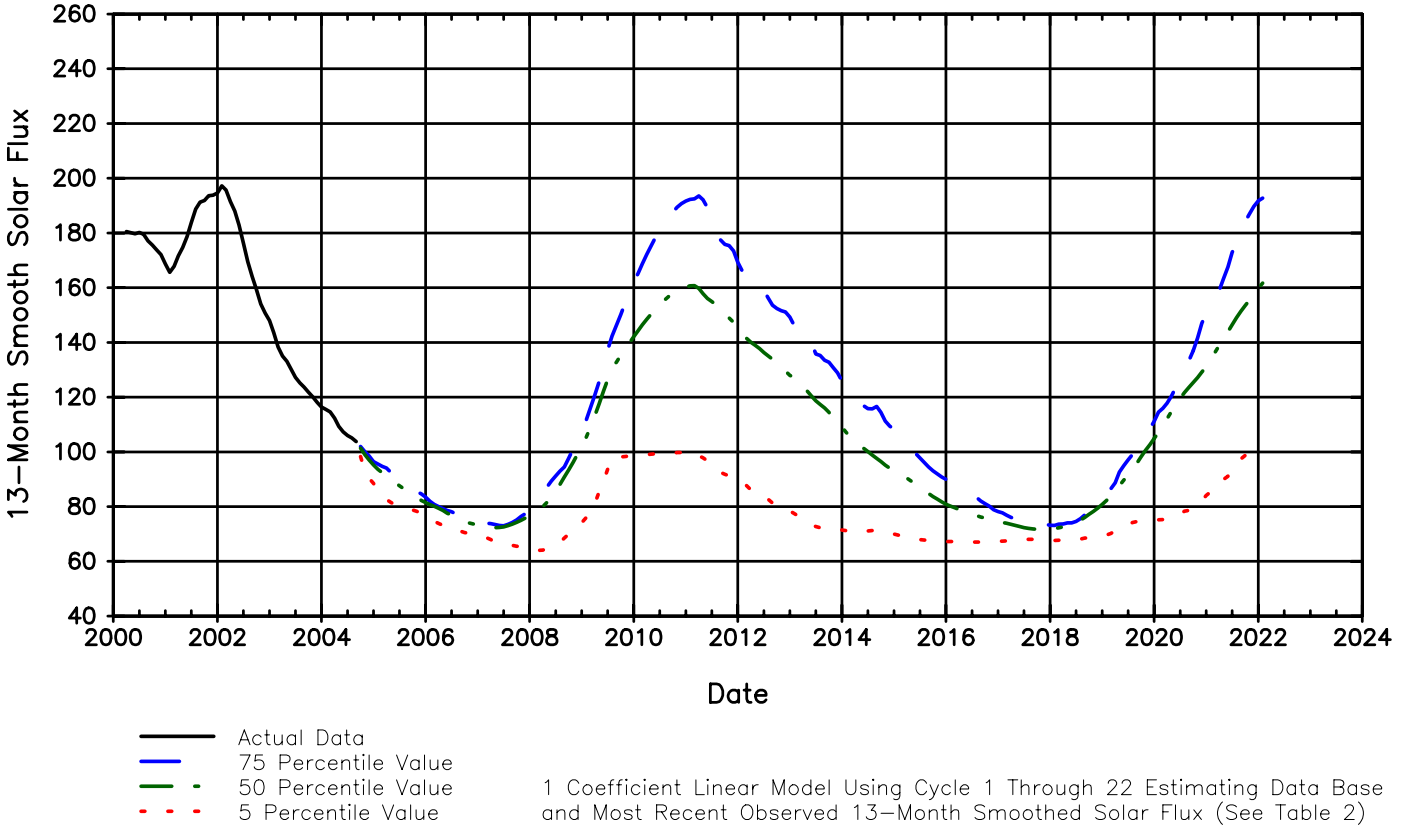

Figure 6. Estimate of 75th Percentile 13-Month Smoothed Solar Flux For Cycle 23* and Cycle 24

* Program Initialized from established Cycle 23 Sunspot Smoothed maximum