

Space Weather Highlights

02-08 June 1997

Solar activity was very low. No optical flares were reported. An 08 degree filament disappeared from the southwest quadrant on 05 June.

Solar wind data were received from the WIND spacecraft a few hours per day. Solar wind velocities were in the 300 - 500 km/sec range. Particle densities generally ranged 02 - 10 p/cc. Bz hovered about zero, varying plus 06 to minus 06 nT (GSM). Solar sector orientation was mostly toward (phi angle near 315 degrees) during 02 - 05 June becoming mostly away (phi angle near 135 degrees) during 06 - 07 June. Orientation became mostly toward again on 08 June.

There were no significant proton enhancements observed at satellite altitudes.

The greater than 2 MeV electron flux reached high levels late 05 - early 06 June.

The geomagnetic field was quiet to unsettled through early 07 June. Activity increased during the latter half of 07 June with brief active periods observed at some high latitude stations. Another round of increased activity began during the latter half of 08 June with active to minor storm levels reported at all latitudes.

Space Weather Forecast

11 June 1997 - 07 July 1997

Solar activity is expected to be very low.

No significant proton enhancements are expected at satellite altitudes.

The greater than 2 MeV electron flux is expected to be normal to moderate.

The geomagnetic field is expected to be quiet to unsettled.



Daily Solar Data

Date	Radio Flux 10.7 cm	Sun spot No.	Sunspot Area (10 ⁶ hemi.)	X-ray Background	X-ray Flux			Flares				
					C	M	X	S	Optical			
									1	2	3	4
02 June	77	35	120	A4.5	0	0	0	0	0	0	0	0
03 June	75	20	150	A4.2	0	0	0	0	0	0	0	0
04 June	74	16	110	A3.6	0	0	0	0	0	0	0	0
05 June	74	15	120	A2.2	0	0	0	0	0	0	0	0
06 June	74	15	110	A2.5	0	0	0	0	0	0	0	0
07 June	75	17	90	A3.3	0	0	0	0	0	0	0	0
08 June	73	36	30	A3.6	0	0	0	0	0	0	0	0

Daily Particle Data

Date	Proton Fluence (protons/cm ² -day-sr)			Electron Fluence (electrons/cm ² -day-sr)		
	>1MeV	>10MeV	>100MeV	>.6MeV	>2MeV	>4MeV
02 June	3.4E+5	1.8E+4	4.6E+3		1.0E+7	
03 June	3.3E+5	1.8E+4	4.4E+3		1.7E+7	
04 June	3.5E+5	1.8E+4	4.5E+3		3.8E+7	
05 June	3.5E+5	1.9E+4	4.6E+3		6.1E+7	
06 June	5.4E+5	1.8E+4	4.7E+3		1.4E+7	
07 June	3.1E+5	1.8E+4	4.3E+3		4.0E+6	
08 June	8.5E+5	1.7E+4	4.1E+3		4.7E+6	

Daily Geomagnetic Data

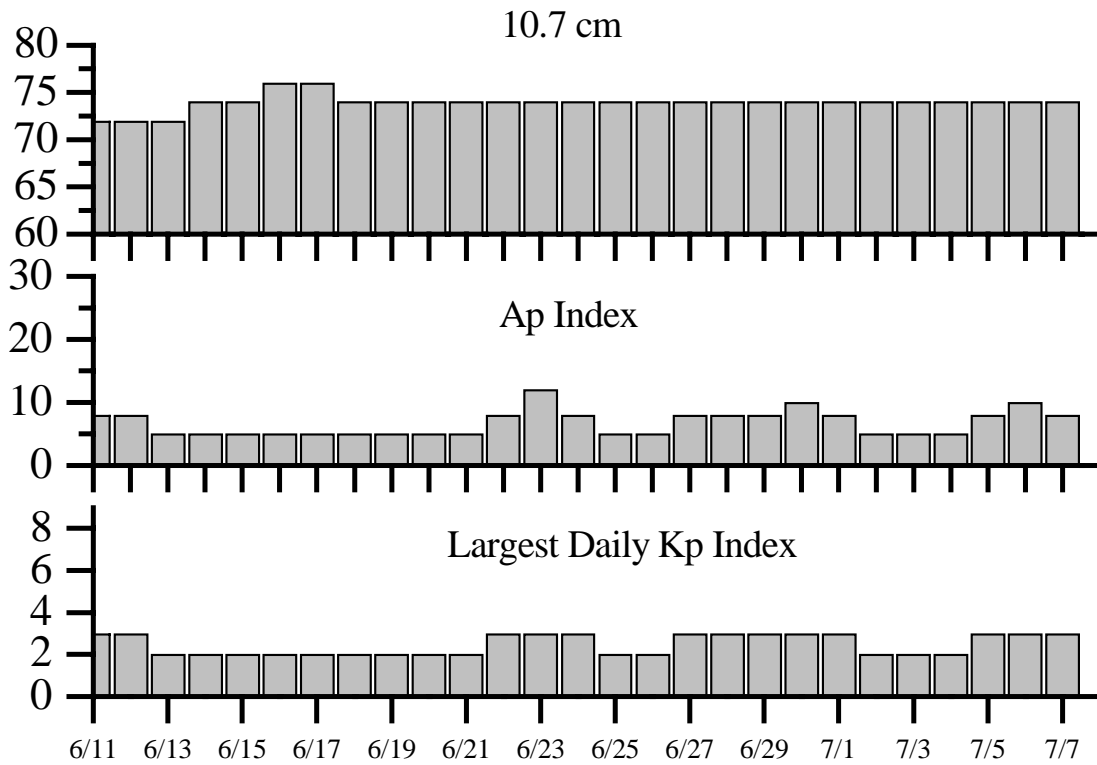
Date	Middle Latitude		High Latitude		Estimated	
	Fredericksburg		College		Planetary	
	A	K-indices	A	K-indices	A	K-indices
02 June	8	2-1-1-1-2-2-3-3	2	2-1-0-1-0-0-1-2	7	2-1-1-1-2-2-3-3
03 June	11	3-2-3-2-2-3-3-2	6	3-3-2-1-2-1-0-0	10	3-3-4-2-2-2-2-2
04 June	8	2-2-1-1-2-2-3-3	*	1-1-0-1-0-1-0-0	5	2-2-1-1-1-2-3-2
05 June	4	1-1-1-1-1-1-2-2	0	0-0-1-0-0-0-0-0	3	1-1-1-0-0-1-2-1
06 June	11	2-2-3-3-3-2-2-3	3	2-2-1-1-1-0-1-1	8	3-2-3-2-2-2-1-2
07 June	10	3-3-2-2-3-2-2-2	10	1-1-3-5-2-2-0-1	11	3-3-2-3-3-2-2-2
08 June	12	1-2-3-2-2-3-3-4	14	0-2-3-4-4-4-1-2	11	1-1-3-3-3-3-3-3

Alerts and Warnings Issued

Date and Time of Issue (UT)	Type of Alert or Warning	Date and Time of Event (UT)
03 Jun 0903	K=4 observed	03 Jun 06-09
05 Jun 1719	>2MeV Electron Event ≥ 1000pfu	05 Jun 1644
07 Jun 0034	>2MeV Electron Event ≥ 1000pfu in progress	06 Jun



Twenty-seven Day Outlook



Date	Radio Flux	Planetary	Largest	Date	Radio Flux	Planetary	Largest
	10.7 cm	A Index	Kp Index		10.7 cm	A Index	Kp Index
11 Jun	72	8	3	25 Jun	74	5	3
12	72	8	3	26	74	5	3
13	72	5	2	27	74	8	3
14	74	5	2	28	74	8	3
15	74	5	2	29	74	8	3
16	76	5	2	30	74	10	3
17	76	5	2	01 Jul	74	5	3
18	74	5	2	02	74	5	2
19	74	5	2	03	74	5	2
20	74	5	2	04	74	5	2
21	74	5	2	05	74	8	3
22	74	8	3	06	74	10	3
23	74	12	3	07	74	8	3
24	74	8	3				



Energetic Event

Date	Time (UT)			X-ray		Optical Information				Peak		Sweep Freq	
	Begin	Max	Max	Class	Integ Flux	Imp Brtns	Location		Rgn #	Radio Flux		Intensity	
							Lat	CMD		245	2695	II	IV

No Event Observed

Flare List

Date	Time			X-ray Class.	Imp / Brtns	Optical		Rgn #
	Begin	Max	End			Lat	CMD	
02 June	No Flares Observed							
03 June	0758	0802	0809	B1.3				
04 June	No Flares Observed							
05 June	No Flares Observed							
06 June	No Flares Observed							
07 June	1313	1316	1322	B1.0				
	1853	1905	1925	B1.8				
08 June	No Flares Observed							

Region Summary

Date	Location		Sunspot Characteristics					Flares							
	° Lat	° CMD	Area (10 ⁻⁶ hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical				
								C	M	X	S	1	2	3	4

Region 8046

23 May	S26E67	268	0000	01	AXX	001	A											
24 May	S25E54	267	0010	03	AXX	002	A											1
25 May	S27E41	267	0010	07	AXX	003	A											1
26 May	S27E28	267	0020	05	BXO	004	B											
27 May	S26E14	268	0010	08	BXO	005	B											
28 May	S27W01	270	0010	00	AXX	001	A											1
29 May	S26W16	272	0000	00	AXX	001	A											1
30 May	S26W29	272	0000	00		000												
31 May	S26W42	272	0000	00		000												1
01 Jun	S26W55	272	0000	00		000												
02 Jun	S26W68	272	0000	00		000												
03 Jun	S26W81	272	0000	00		000												

0 0 0 5 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 270



Region Summary - continued.

Date	Location		Sunspot Characteristics				Flares							
	(° Lat ° CMD)	Helio	Area (10 ⁻⁶ hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
		Lon						C	M	X	S	1	2	3

Region 8047

27 May	N26E68	214	0010	07	BXO	004	B												
28 May	N26E55	214	0020	07	BXO	004	B												
29 May	N26E44	212	0050	09	CRO	006	B												
30 May	N27E31	211	0030	08	CRO	003	B												
31 May	N27E19	210	0020	08	CRO	003	B												
01 Jun	N26E08	208	0020	05	CRO	003	B												
02 Jun	N26W04	206	0000	01	AXX	002	A												
03 Jun	N26W17	206	0000	00		000													
04 Jun	N26W30	206	0000	00		000													
05 Jun	N26W43	206	0000	00		000													
06 Jun	N26W56	206	0000	00		000													
07 Jun	N26W69	206	0000	00		000													
08 Jun	N26W82	206	0000	00		000													

0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 206

Region 8048

30 May	S28E55	187	0000	00	AXX	001	A												
31 May	S29E41	188	0030	06	BXO	006	B												
01 Jun	S29E28	188	0050	06	CRO	010	B												
02 Jun	S28E15	187	0120	07	DSO	013	B												
03 Jun	S28E03	186	0150	09	DSO	010	B												
04 Jun	S28W13	188	0110	10	DSO	006	B												
05 Jun	S27W24	186	0120	10	DAO	005	B												
06 Jun	S28W37	186	0110	10	DAO	005	B												
07 Jun	S28W50	186	0090	10	DSO	007	B												
08 Jun	S28W65	188	0030	11	CSO	004	B												

0 0 0 2 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 186



Region Summary - continued.

Date	Location		Sunspot Characteristics				Flares							
	(° Lat ° CMD)	Helio	Area (10 ⁻⁶ hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
		Lon						C	M	X	S	1	2	3

Region 8049

30 May	S26E17	225	0000	00	AXX	001	A												
31 May	S26E04	225	0000	00		000													
01 Jun	S26W09	225	0000	00		000													
02 Jun	S26W22	225	0000	00		000													
03 Jun	S26W35	225	0000	00		000													
04 Jun	S26W48	225	0000	00		000													
05 Jun	S26W61	225	0000	00		000													
06 Jun	S26W74	225	0000	00		000													
07 Jun	S26W87	225	0000	00		000													
																			0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 225

Region 8050

08 Jun	N27E56	067	0000	01	AXX	001	A												
																			0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 67

Region 8051

08 Jun	N21W09	132	0000	00	AXX	001	A												
																			0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 132



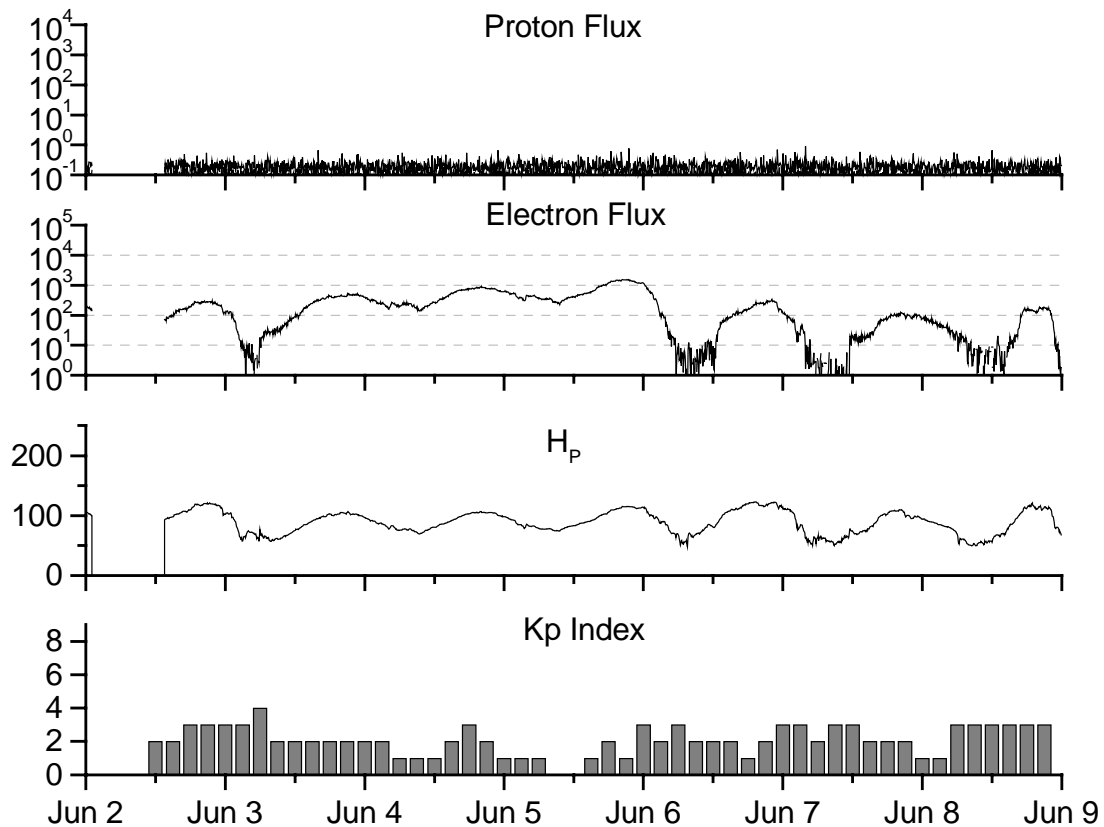
**Recent Solar Indices (preliminary)
of the observed monthly mean values**

Month	Sunspot Numbers					Radio Flux		Geomagnetic	
	Observed values SWO	RI	Ratio RI/SWO	Smooth values SWO	RI	**Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
1995									
June	27.8	15.6	0.56	29.9	18.2	75.7	77.7	11	12.7
July	23.8	14.5	0.61	28.1	17.0	73.9	76.9	08	12.4
August	25.1	14.3	0.57	25.4	15.4	73.8	76.0	09	12.1
September	16.5	11.8	0.72	22.0	13.4	72.0	74.8	13	11.8
October	31.6	21.1	0.67	19.7	12.1	77.9	73.8	16	11.4
November	15.7	09.0	0.57	18.5	11.4	74.2	73.2	09	10.7
December	16.2	10.0	0.62	17.6	10.8	72.6	72.8	09	10.0
1996									
January	17.6	11.5	0.55	16.8	10.4	74.5	72.4	09	09.8
February	09.1	04.4	0.48	16.2	10.1	71.5	72.2	10	09.8
March	12.1	09.2	0.76	15.4	09.7	70.7	72.1	11	09.9
April	08.5	04.8	0.60	13.6	08.5*	69.3	71.6	11	09.6*
May	11.8	05.5	0.47	12.9	08.1*	70.1	71.4	07	09.3*
June	18.8	11.8	0.63	13.5	08.6*	69.6	71.8	05	09.0*
July	13.2	08.8	0.67	13.4	08.5*	71.2	72.0	07	08.9*
August	20.5	14.4	0.68	13.1	08.5*	72.4	72.1	09	08.8*
September	02.9	01.8	0.62	13.3	08.6*	69.4	72.3	15	08.7*
October	02.3	01.8*	0.78*	14.0	09.0*	69.2	72.4	13	08.5*
November	26.7	18.6*	0.70*	15.4	10.0*	78.7	73.0-	08	08.5*
December	21.1	12.7*	0.60*			77.8		07	
1997									
January	09.0	06.5*	0.72*			74.0		09	
February	11.3	07.6*	0.67*			73.8		11	
March	14.4	08.8*	0.61*			73.5		08	
April	24.5	15.8*	0.64*			74.5		10	
May	28.6	18.5	0.64			74.8		18	

*Preliminary estimates.

The lowest smoothed sunspot indices number for Cycle 21, RI = 12.3, occurred September 1986. The highest smoothed sunspot number for Cycle 22, RI=158.5, occurred July 1989.





Weekly Geosynchronous Satellite Environment Summary

Week Beginning 02 June 1997

Protons plot contains the five minute averaged integral proton flux (protons/ cm^2 -sec-sr) as measured by GOES-9 (W135) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

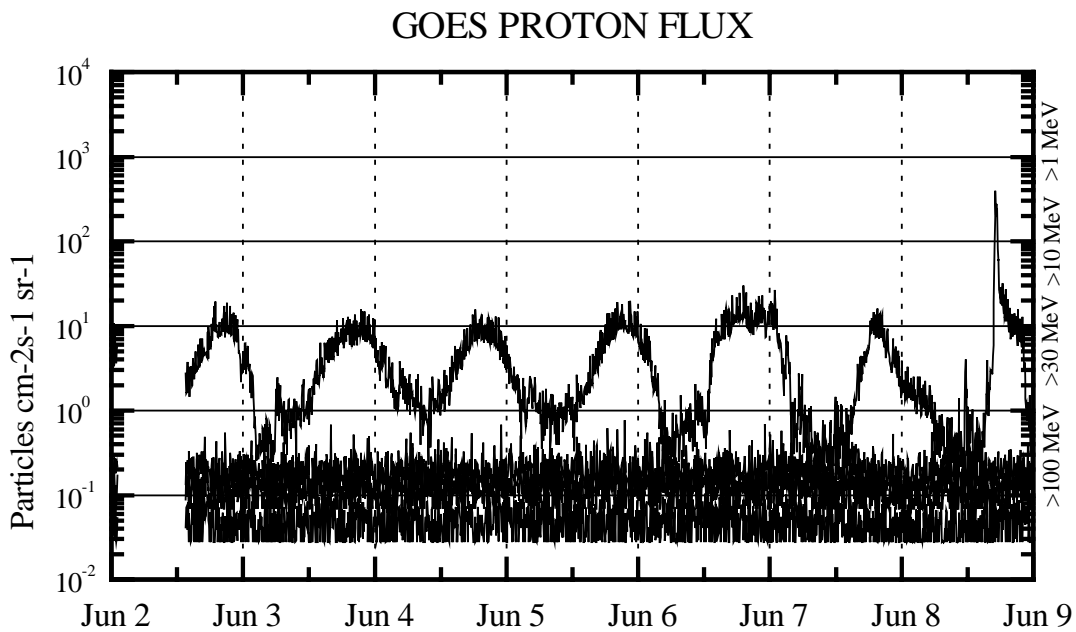
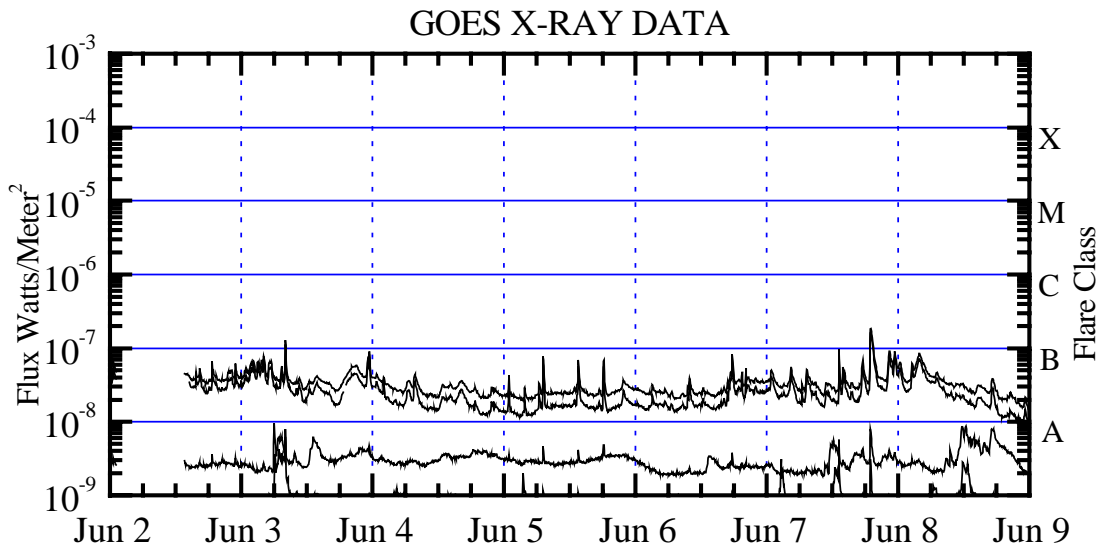
Electrons plot contains the five minute averaged integral electron flux (electrons/ cm^2 -sec-sr) with energies greater than 2 MeV at GOES-9.

H_p plot contains the five minute averaged magnetic field H component in nanoteslas (nT) as measured by GOES-9. The H component is parallel to the spin axis of the satellite, which is nearly parallel to the Earth's rotation axis.

K_p plot contains the estimated planetary 3-hour K-index (derived by the USAF 55th Space Weather Squadron) in real time from magnetometers at Meanook, Canada; Sitka, AK; Glenlea, Canada; St. Johns, Canada; Ottawa, Canada; Newport, WA; Fredericksburg, VA; Boulder, CO; Fresno, CA. These data are made available through cooperation from the Geological Survey of Canada (GSC) and the US Geological Survey. These may differ from the final K_p values derived from a more extensive network of magnetometers.

The data included here are those now available in real time at the SWO and are incomplete in that they do not include the full set of parameters and energy ranges known to cause satellite operating anomalies. The proton and electron fluxes and K_p are "global" parameters that are applicable to a first order approximation over large areas. H_p is subject to a more localized phenomena and the measurements generally are applicable to within a few degrees of longitude of the measuring satellite.





Weekly GOES Satellite X-ray and Proton Plots

Proton plot contains the five minute averaged integral proton flux (protons/cm²-sec-sr) as measured by GOES-9 (W135) for each of the energy thresholds: >1, >10, >30 and >100 MeV. P10 event threshold is 10 pfu (protons/cm²-sec-sr) at greater than 10 MeV.

X-ray plot contains five minute averaged x-ray flux (watts/m²) as measured by GOES 8 and 9 in two wavelength bands, .05 -.4 and .1 -.8 nm. The letters A, B, C, M and X refer to x-ray event levels for the .1 -.8 nm band.



What to Expect During Cycle 23

We are now in the minimum between solar cycles 22 and 23. We expect Cycle 23 to be another large cycle, comparable to the last two cycles, but do not expect it to exceed Cycle 19, the largest cycle on record. SEC is predicting Cycle 23 to reach a smoothed sunspot number maximum of 160 (± 30) early in the year 2000. The smoothed 10.7 cm radio flux maximum is expected to be 205 (± 30).

Based on these predictions, what can one expect of Cycle 23 in terms of space weather? To attempt to answer this question, we examined data from recent cycles. The accompanying plots (see p. 12) show annual averaged numbers of solar optical flares (for Cycles 19 - 22), >10 MeV energetic proton events (for Cycles 19 - 22), M- and X-class X-ray solar flares (for Cycles 20 - 22), and geomagnetic storm days (for Cycles 18 - 22) as a function of year in the solar cycle. Since we expect Cycle 23 activity to be comparable to recent cycles, these plots may be used to get a general idea of what to expect in the next 10 years. It is important to note that we are not attempting to forecast the magnitude or time of a specific event; rather we are providing general guidance for the frequency distribution of events during Cycle 23.

Flare Activity:

The greatest number of optical flares occurs during cycle maximum (see the optical flares plot) and Cycle 23 is expected to be no exception. The greatest number of flares is most likely to occur during the year of maximum, which in this case is 2000. Flare occurrences are expected to decline after 2002.

Most major flare production (x-ray class \geq M5) is expected during 1999 to 2003. On average, M-class flares are expected to occur more than once per day during the same interval. The greatest increase in M- and X-class X-ray flares is likely to occur during maximum (2000), returning to low levels during 2004.

>10 MeV Proton Events:

Most energetic proton events are associated with M- and X-class flares even though most M- and X-class flares are not accompanied by proton events. Based on data from previous cycles, most >10 MeV proton events are expected to occur from 1999 to 2003.

Geomagnetic Storms:

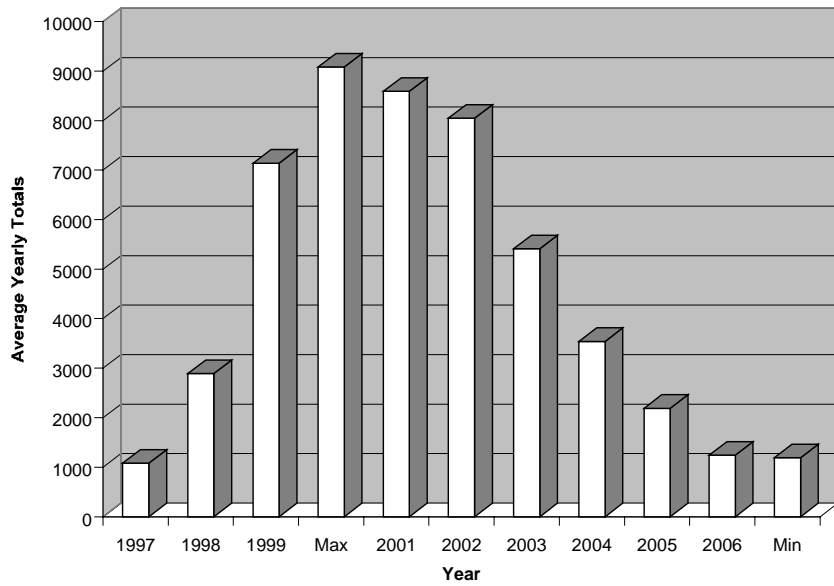
We expect Cycle 23 geomagnetic activity to be near the levels experienced in earlier cycles with the highest number of storm days expected during the years 1999 - 2006.

Minor storm activity (days with A_p 30 - 49) occurs most often during the declining phase of the solar cycle, due to the increased presence and influence of coronal holes. Using recent cycle activity as a guide, expect most minor storm days to occur during 2005. Major storms (days with A_p 50 - 99) are likely during the 1999 - 2005 time frame. During recent cycles most major storm days occurred during the second year after sunspot maximum (2002 for Cycle 23). Severe storm (days with $A_p \geq 100$) occurrences are not well predicted due to their rarity.

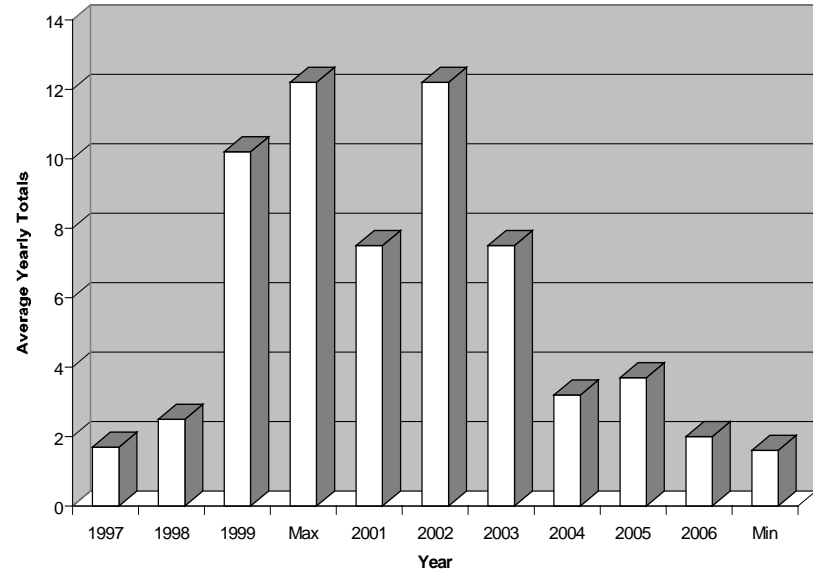


Event Occurrence Projection for Solar Cycle 23

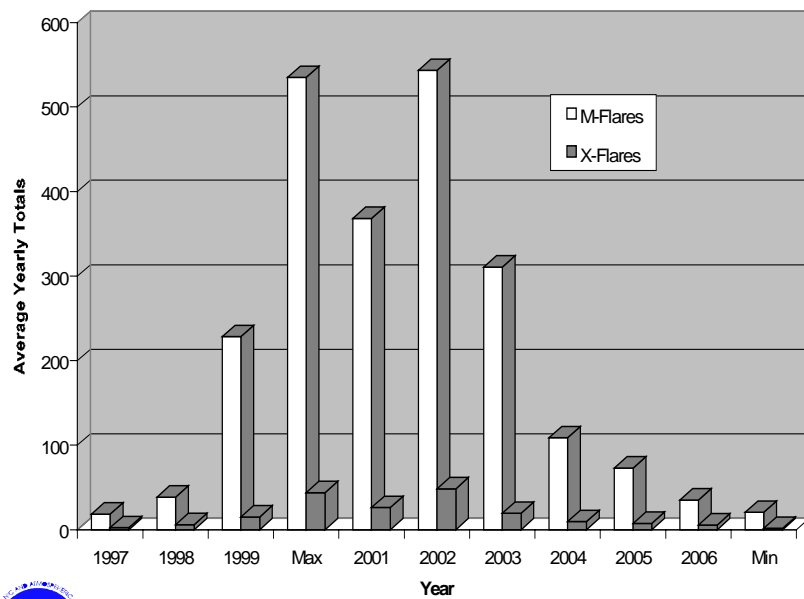
Averaged Optical Flares (Cycles 19-22)



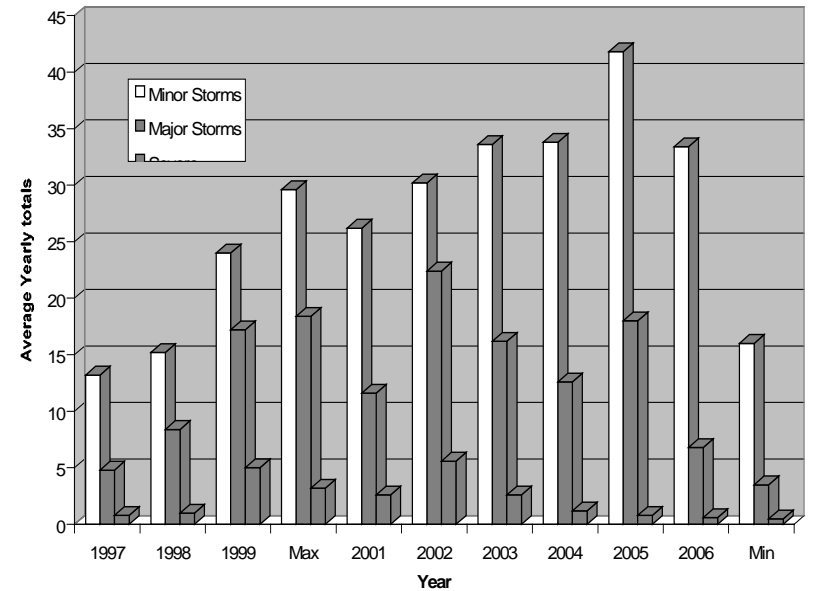
Averaged >10 MeV Proton Events (Cycles 19-22)



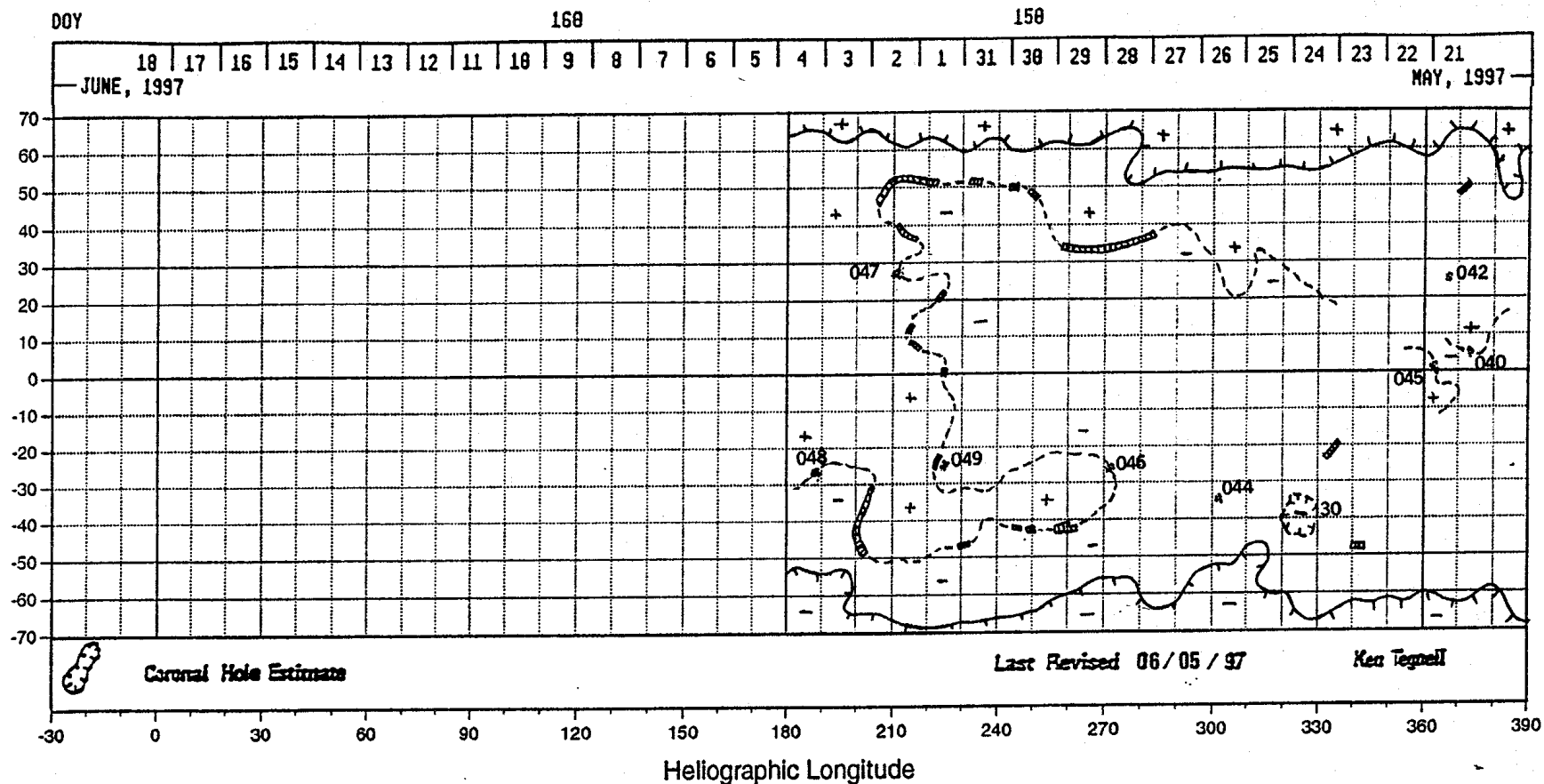
Averaged X-Ray Flares (Cycles 20-22)



Averaged Geomagnetic Storm Days (Cycles 18-22)



Carrington Rotation 1923



H α Synoptic Chart - a partial and preliminary map of the sun in absolute heliographic coordinates (solar latitude and longitude). The Carrington Rotation serial number appearing at the top of the chart is a continuation of the sequence begun by R. Carrington on 09 November 1852. Dates along the top of the chart are the times of central meridian passage of the solar longitudes directly below those dates. Features on the map are as follows: filaments (cross-hatched areas), filament channels (solid lines outside an active area), plage corridors (solid lines inside an active area), 01 and estimated neutral lines (dashed lines) are lines of magnetic polarity change (neutral lines), plages (dotted areas whose dot density is roughly equal to brightness), strong active regions (stippled areas overlaid with diagonal lines; source of x-ray flares class M2 or greater, or two or more class M1 flares), large sunspots (large dots), coronal holes (solid lines with tick marks directed toward center of coronal hole, from 1083 nm spectroheliograms), SWO region number showing the last 3 digits of a 4-digit number.



