

**Space Weather Highlights
22-28 March 1999**

Solar activity was very low during most of the period. All sunspot groups were small, simply structured, and stable.

Real-time solar wind data were available from the Advanced Composition Explorer (ACE) spacecraft for most of the period. There were two periods of interest. The first occurred as a transient passed the spacecraft late on 25 March with an associated density increase to 23 p/cc, a minor velocity increase, and southerly IMF Bz deflections to minus 13 nT (GSM). This transient may have been associated with a partial-halo CME observed on 21 March. The second period of interest occurred late on 28 March as densities increased to 28 p/cc. Earth was within an away (positive polarity) solar sector throughout the period.

There were no significant proton flux enhancements detected at geo-synchronous altitude.

The greater than 2 MeV electron flux at geo-synchronous altitude was at normal levels during most of the period.

The geomagnetic field was quiet during most of the period. However, the field became mildly disturbed late on 25 March with unsettled to active periods. This activity was related to the transient passage discussed in the solar wind summary above.

**Space Weather Outlook
31 March - 26 April 1999**

Solar activity is expected to be at low to moderate levels. Isolated M-class flares are possible during the first half of April with the anticipated return of old active Region 8485 (N23, L = 277).

No significant proton flux enhancements are expected at geo-synchronous altitude.

The greater than 2 MeV electron flux at geo-synchronous altitude is expected to be at normal to moderate levels.

The geomagnetic field may be disturbed through 02 April with brief active to minor storm periods due to recurrent coronal hole effects. Active to minor storm periods are also possible during 25 - 26 April due to recurrent coronal hole effects.



Daily Solar Data

Date	Radio Flux 10.7 cm	Sun spot No. (10 ⁶ hemi.)	Sunspot Area	X-ray Background	Flares							
					X-ray Flux			Optical				
					C	M	X	S	1	2	3	4
22 March	116	101	160	B2.8	1	0	0	0	0	0	0	0
23 March	113	33	90	B1.6	0	0	0	0	0	0	0	0
24 March	108	52	180	B1.5	0	0	0	0	0	0	0	0
25 March	107	48	210	B1.4	0	0	0	2	0	0	0	0
26 March	104	33	120	B1.1	0	0	0	0	0	0	0	0
27 March	105	45	130	B1.1	0	0	0	1	0	0	0	0
28 March	103	65	170	B1.1	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
22 March	3.0E+4	1.4E+4	2.9E+3		8.2E+5	
23 March	8.1E+4	1.3E+4	3.0E+3		1.5E+6	
24 March	4.5E+4	1.3E+4	2.9E+3		2.8E+6	
25 March	1.2E+5	1.3E+4	2.8E+3		4.0E+6	
26 March	6.9E+4	1.3E+4	2.9E+3		1.2E+6	
27 March	8.4E+4	1.4E+4	3.1E+3		1.2E+6	
28 March	1.1E+5	1.3E+4	2.9E+3		1.7E+6	

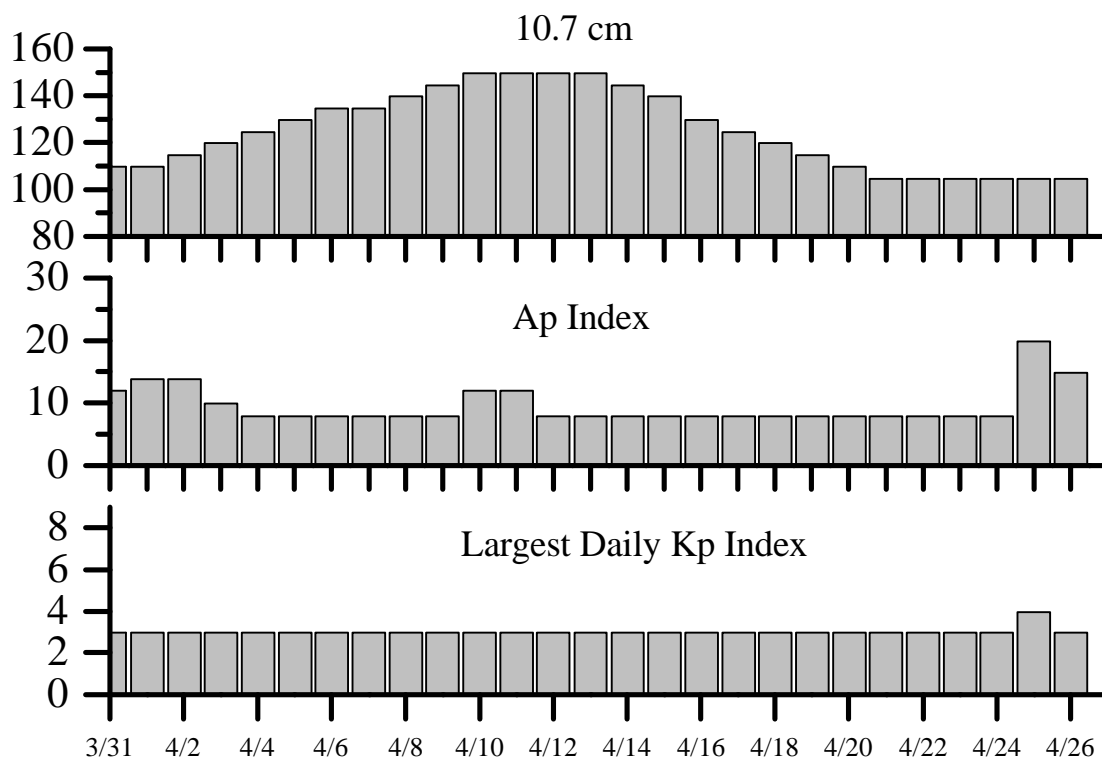
Daily Geomagnetic Data

Date	Middle Latitude		High Latitude		Estimated	
	Fredericksburg		College		Planetary	
	A	K-indices	A	K-indices	A	K-indices
22 March	3	0-0-0-1-2-1-1-2	*	*_*_*_*_*_*_*_*	3	0-0-0-1-2-2-2-1
23 March	7	2-1-1-1-2-2-2-3	*	*_*_*_*_*_*_*_*	5	1-0-1-1-2-2-2-3
24 March	4	1-1-1-2-1-1-1-1	*	*_*_*_*_*_*_*_*	4	0-0-1-2-1-2-1-1
25 March	5	0-0-0-1-2-2-3-2	*	*_*_*_*_*_*_*_*	8	0-0-0-2-1-3-4-3
26 March	7	2-2-1-3-3-1-0-1	*	*_*_*_*_*_*_*_*	6	1-2-2-3-2-2-1-0
27 March	3	0-1-2-1-1-0-1-2	*	*_*_*_*_*_*_*_*	4	0-1-2-0-1-1-1-2
28 March	7	2-2-3-2-2-1-1-1	*	*_*_*_*_*_*_*_*	6	1-2-3-2-2-2-1-1

Alerts and Warnings Issued

Date and Time of Issue (UT)	Type of Alert or Warning	Date and Time of Event (UT)
No Alerts Issued		





Twenty-seven Day Outlook

Date	Radio Flux 10.7 cm	Planetary A Index	Largest Kp Index	Date	Radio Flux 10.7 cm	Planetary A Index	Largest Kp Index
31 Mar	110	12	3	14	145	8	3
01 Apr	110	14	3	15	140	8	3
02	115	14	3	16	130	8	3
03	120	10	3	17	125	8	3
04	125	8	3	18	120	8	3
05	130	8	3	19	115	8	3
06	135	8	3	20	110	8	3
07 Apr	135	8	3	21	105	8	3
08	140	8	3	22	105	8	3
09	145	8	3	23	105	8	3
10	150	8	3	24	105	8	3
11	150	12	3	25	105	20	4
12	150	12	3	26	105	15	3
13	150	8	3				



Energetic Events

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

No Events Observed

Flare List

Date	Time			X-ray Class.	Optical		Rgn #
	Begin	Max	End		Imp / Brtns	Location Lat CMD	
22 March	0138	0152	0159	C1.4			
23 March	1007	1017	1024	B2.8			
	1646	1658	1704	B3.5			
	2116	2119	2123	B2.2			
24 March	0951	0955	1001	B2.9			
	1245	1252	1300	B3.4			
25 March	B0706	0711	0729		SF	N26W8	8493
	1438	1440	1450		SF	S25W62	8494
26 March	0121	0128	0135	B3.5			
27 March	B1107	U1107	A112		SF	N26E75	8501
28 March	0020	0026	0037	B2.3			
	0142	0145	0147	B1.7			
	1833	1837	1843	B2.3			
	2123	2148	2236	B2.0			



Region Summary

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	4		
<i>Region 8484</i>																	
08 Mar	S22E76	266	0100	03	HHX	001	A	1			1						
09 Mar	S24E64	266	0190	05	DAO	002	B	2			3	2					
10 Mar	S23E54	263	0140	04	DAO	005	B				1						
11 Mar	S23E41	262	0120	06	DAO	009	B										
12 Mar	S22E30	260	0090	05	DSO	008	B										
13 Mar	S23E18	259	0070	04	DSO	011	B										
14 Mar	S24E05	259	0060	05	DSO	010	B										
15 Mar	S23W08	259	0040	04	CSO	007	B										
16 Mar	S23W21	259	0040	04	CSO	006	B										
17 Mar	S23W34	258	0020	03	CSO	004	B										
18 Mar	S23W46	257	0010	04	BXO	003	B										
19 Mar	S23W59	257	0010	01	AXX	001	A										
20 Mar	S25W71	256	0000	00	AXX	001	A										
21 Mar	S25W84	256	0000	00		000											
								2	1	0	5	2	0	0	0	0	

Crossed West Limb.

Absolute heliographic longitude: 259

Region 8487

11 Mar	N17E63	240	0020	08	BXO	003	B	3			13						
12 Mar	N17E51	239	0090	08	CAO	008	B	6			16	2					
13 Mar	N17E39	238	0100	10	DAO	016	B	4	1		15						
14 Mar	N16E25	239	0190	11	ESI	020	B	1	2		2	1					
15 Mar	N16E11	240	0200	12	EAI	018	B		1		4	1					
16 Mar	N17W01	239	0180	12	ESI	022	B				5						
17 Mar	N17W15	239	0180	12	ESI	021	B				1						
18 Mar	N17W25	236	0150	14	CSO	017	B										
19 Mar	N16W45	243	0160	03	HAX	002	A										
20 Mar	N17W59	244	0100	02	HSX	003	A										
21 Mar	N17W72	244	0090	05	CSO	002	B										
22 Mar	N16W86	244	0030	03	BXO	002	B										
								14	4	0	56	4	0	0	0	0	

Crossed West Limb.

Absolute heliographic longitude: 239



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
<i>Region 8488</i>														
14 Mar	S27E37	227	0020	03	CSO	004	B							
15 Mar	S26E22	229	0000	03	BXO	003	B							
16 Mar	S26E09	229	0020	03	CSO	003	B							
17 Mar	S26W04	228	0040	05	CSO	008	B							
18 Mar	S26W17	228	0110	07	DSO	018	B							
19 Mar	S27W30	228	0090	08	DAO	014	B							
20 Mar	S26W44	229	0030	07	CSO	006	B							
21 Mar	S26W58	230	0010	02	AXX	002	A							
22 Mar	S26W72	230	0000	01	AXX	002	A							
23 Mar	S26W85	230	0000	00		000								

0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 228

Region 8490

17 Mar	S20E66	158	0000	00	AXX	001	A							
18 Mar	S19E54	157	0000	00	AXX	001	A							
19 Mar	S19E40	158	0010	01	AXX	002	A							
20 Mar	S19E27	158	0010	01	BXO	003	B							
21 Mar	S18E10	162	0010	03	BXO	003	B							
22 Mar	S17W02	160	0000	00	AXX	001	A							
23 Mar	S17W15	160												
24 Mar	S17W28	160												
25 Mar	S17W41	160												
26 Mar	S17W54	160												
27 Mar	S17W67	160												
28 Mar	S17W80	160												

0 0 0 0 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 160

Region 8491

18 Mar	N19W09	220	0010	06	BXO	008	B							
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0 0 0 0 0 0 0 0

Died on Disk.

Absolute heliographic longitude: 220



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 8492

19 Mar	S27W46	244	0010	02	AXX	002	A												
20 Mar	S27W59	244																	
21 Mar	S27W72	244																	
22 Mar	S27W85	244																	
												0	0	0	0	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 244

Region 8493

19 Mar	N19W22	220	0040	07	CRO	016	B	2			2								
20 Mar	N20W36	221	0030	06	DSO	011	B												
21 Mar	N20W50	222	0020	05	BXO	004	B												
22 Mar	N19W62	220	0020	05	BXO	005	B												
23 Mar	N19W75	220	0000	00		000													
24 Mar	N19W88	220	0000	00		000													
												2	0	0	2	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 220

Region 8494

19 Mar	S22E15	183	0010	05	BXO	006	B												
20 Mar	S23E02	183	0010	04	BXO	004	B												
21 Mar	S24W12	184	0030	04	CRO	007	B												
22 Mar	S23W24	182	0010	03	BXO	003	B												
23 Mar	S23W37	182	0000	00		000													
24 Mar	S23W50	182	0000	00		000													
25 Mar	S23W63	182	0000	00		000													1
26 Mar	S23W76	182	0000	00		000													
27 Mar	S23W89	182	0000	00		000													
												0	0	0	1	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 183



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 8495

19 Mar	S21E62	136	0000	00	AXX	001	A											
20 Mar	S21E47	138	0000	07	BXO	002	B											
21 Mar	S21E33	139	0010	07	BXO	002	B											
22 Mar	S21E23	135	0000	01	AXX	002	A											
23 Mar	S21E10	135																
24 Mar	S21W03	135																
25 Mar	S21W16	135																
26 Mar	S21W29	135																
27 Mar	S21W42	135																
28 Mar	S22W51	130	0010	03	BXO	007	B											
												0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 135

Region 8496

19 Mar	S11W03	201	0020	03	BXO	005	B											
20 Mar	S09W18	203	0040	06	CAO	009	B											
21 Mar	S11W32	204	0060	06	DAO	007	B											
22 Mar	S10W44	202	0040	07	CSO	005	B											
23 Mar	S12W59	204	0000	01	AXX	001	A											
24 Mar	S11W72	204	0030	06	BXO	005	B											
25 Mar	S11W89	208	0000	00	AXX	001	A											
												0	0	0	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 201

Region 8497

22 Mar	N30E60	098	0060	03	HSX	001	A											
23 Mar	N30E49	096	0040	02	HSX	001	A											
24 Mar	N28E37	095	0070	02	HSX	001	A											
25 Mar	N29E25	094	0080	02	HSX	001	A											
26 Mar	N30E12	094	0060	02	HSX	001	A											
27 Mar	N29W01	094	0070	02	HSX	001	A											
28 Mar	N29W13	092	0070	02	HSX	001	A											
												0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 094



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	4									
<i>Region 8498</i>																								
23 Mar	N18E67	078	0050	02	HSX	001	A																	
24 Mar	N17E54	078	0050	02	HSX	001	A																	
25 Mar	N17E42	077	0060	02	HAX	003	A																	
26 Mar	N18E29	077	0060	02	HSX	001	A																	
27 Mar	N18E16	077	0050	02	HSX	001	A																	
28 Mar	N18E03	076	0050	02	HSX	002	A																	
																						0 0 0 0 0 0 0 0		
Still on Disk.																								
Absolute heliographic longitude: 076																								
<i>Region 8499</i>																								
24 Mar	N23W39	171	0030	05	CRO	005	B																	
25 Mar	N22W50	169	0070	06	DSO	003	B																	
26 Mar	N23W62	168	0000	00	AXX	001	A																	
27 Mar	N23W75	168																						
28 Mar	N23W88	168																						
																							0 0 0 0 0 0 0 0	
Still on Disk.																								
Absolute heliographic longitude: 171																								
<i>Region 8500</i>																								
27 Mar	N16E02	091	0000	00	AXX	001	A																	
28 Mar	N16W11	091																						
																							0 0 0 0 0 0 0 0	
Still on Disk.																								
Absolute heliographic longitude: 091																								
<i>Region 8501</i>																								
27 Mar	N28E66	027	0010	02	BXO	002	B																	1
28 Mar	N29E55	024	0040	08	CSO	004	B																	
																								0 0 0 1 0 0 0 0
Still on Disk.																								
Absolute heliographic longitude: 024																								
<i>Region 8502</i>																								
28 Mar	S25E71	008	0000	00	AXX	001	A																	
																								0 0 0 0 0 0 0 0
Still on Disk.																								
Absolute heliographic longitude: 008																								



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

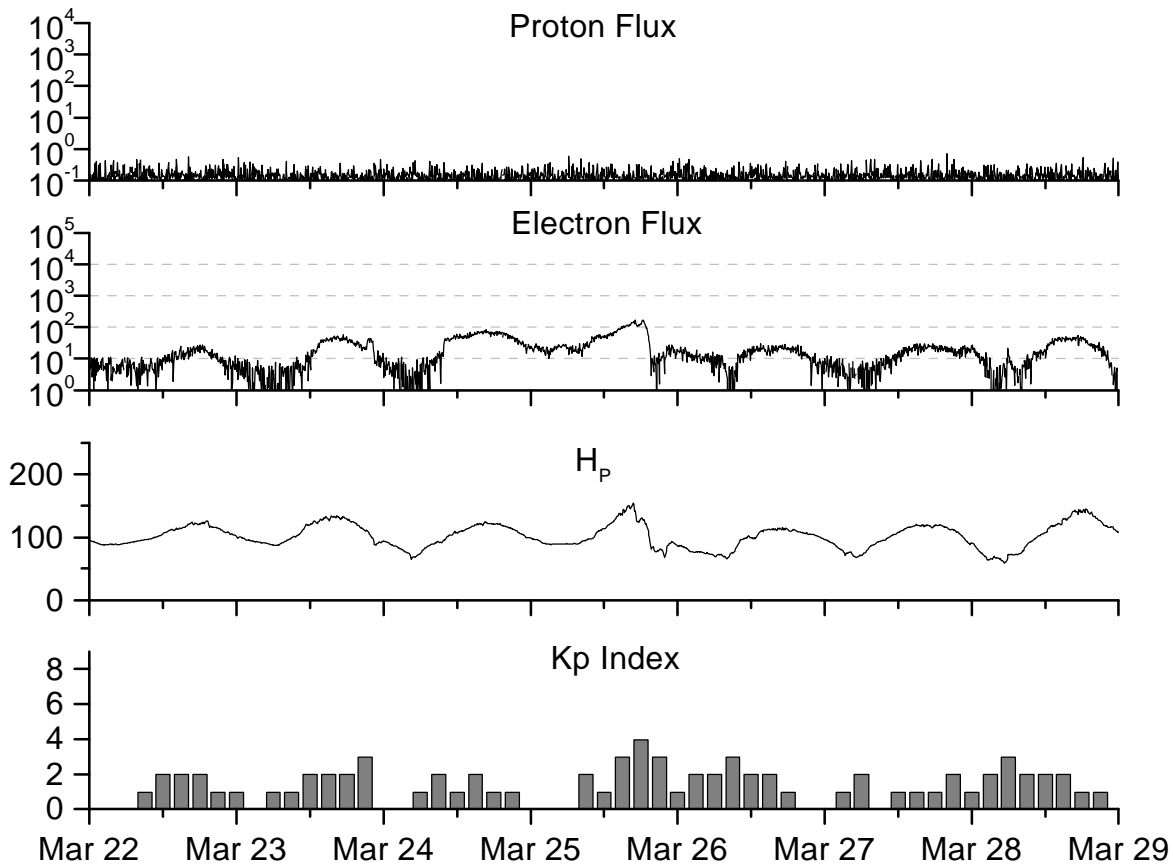
Month	Sunspot Numbers			Radio Flux		Geomagnetic			
	Observed values SWO	Ratio RI	Ratio RI/SWO	Smooth values SWO	Ratio RI	**Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
1997									
March	14.4	08.7	0.60	20.4	13.5	73.5	75.1	08	08.9
April	24.5	15.5	0.63	24.0	16.5	74.5	76.8	10	08.6
May	28.6	18.5	0.65	26.4	18.3	74.6	78.4	08	08.6
June	22.1	12.7	0.57	29.0	20.3	71.7	80.1	07	08.6
July	17.0	10.4	0.61	32.4	22.6	71.1	81.8	06	08.5
August	36.7	24.4	0.66	35.9	25.0	79.0	83.4	07	08.3
September	52.8	51.3	0.88	40.5	28.3	96.2	85.7	10	08.4
October	33.6	22.8	0.68	45.4	31.8	84.9	88.6	11	08.6
November	53.5	39.0	0.73	49.3	35.0	99.5	91.3	11	09.0
December	57.9	41.2	0.71	54.2	39.0*	98.8	94.2*	05	09.5
1998									
January	51.8	31.9	0.62	60.6	43.7*	93.4	97.5*	08	09.9*
February	54.4	40.3	0.74	67.4	48.8*	93.4	101.7*	08	10.5*
March	81.8	54.8	0.67	73.3	53.4*	109.1	105.8*	13	11.2*
April	73.6	53.4	0.73	77.7	56.5*	108.3	109.1*	10	11.4*
May	74.3	56.3	0.76	81.4	59.3*	106.7	112.4*	18	11.7*
June	93.6	70.7*	0.76*	85.9	62.4*	108.4*	116.2*	10	12.0*
July	98.3	66.2*	0.67*	90.3	65.4*	114.0*	120.3*	11*	12.2*
August	118.6	91.7*	0.77*			136.0*		18*	
September	119.0	92.9*	0.78*			138.4*		14*	
October	77.0	55.6*	0.72*			121.9*		13*	
November	99.5	73.6*	0.74*			140.2*		16*	
December	120.8	81.6*	0.68*			150.1*		08*	
1999									
January	94.3	62.4*	0.66*			140.6*		08*	
February	93.4	66.1	0.70*			142.0*		11*	

*Preliminary estimates.

The lowest smoothed sunspot indices number for Cycle 22, RI = 8.0, occurred in May 1996. The highest smoothed sunspot number for Cycle 22, RI=158.5 occurred July 1989.

** From June 1991 onward, the 10.7-cm radio flux data source is Penticton, B.C. Canada. Prior to that, it was Ottawa.





Weekly Geosynchronous Satellite Environment Summary
Week Beginning 22 March 1999

Protons plot contains the five-minute averaged integral proton flux (protons/ cm²-sec-sr) as measured by GOES-8 (W75) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

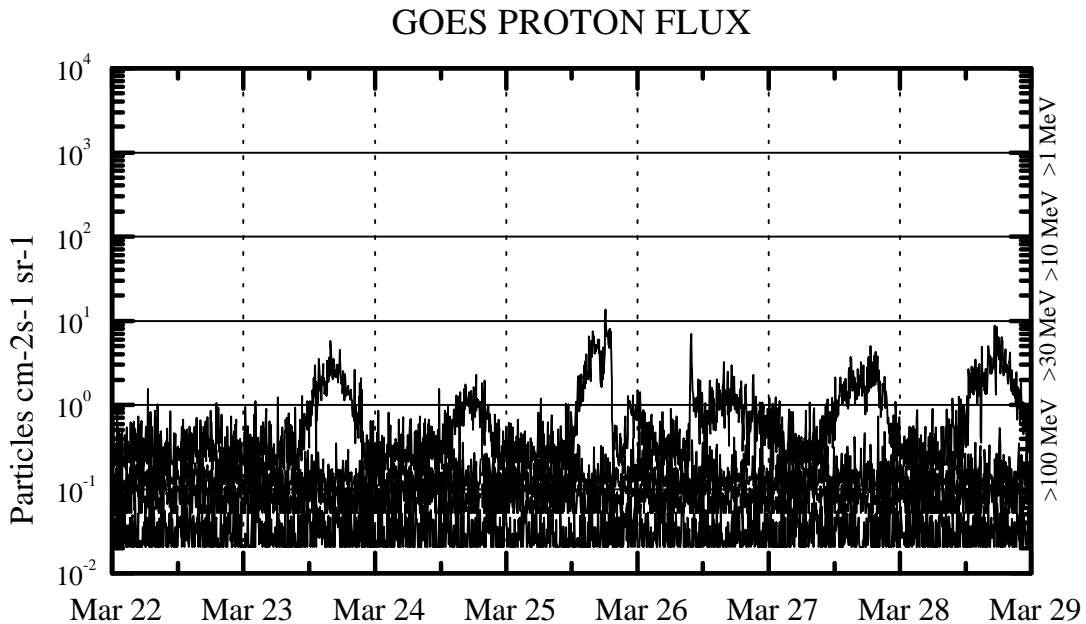
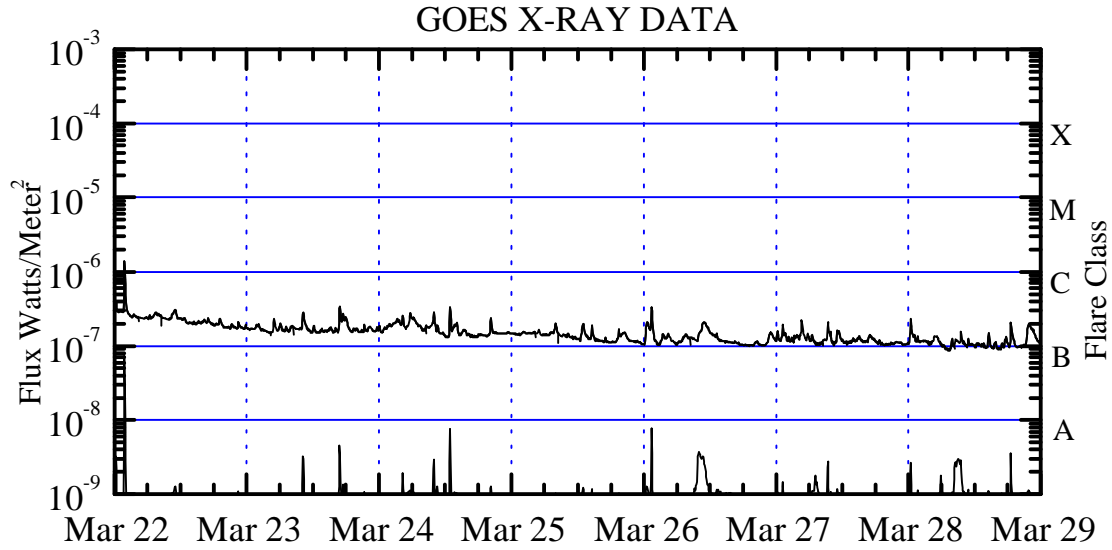
Electrons plot contains the five-minute averaged integral electron flux (electrons/ cm²-sec-sr) with energies greater than 2 MeV at GOES-8.

H_p plot contains the five minute averaged magnetic field H component in nanoteslas (nT) as measured by GOES-8. 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 and Heartland, UK. 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

X-ray plot contains five minute averaged x-ray flux (watts/m²) as measured by GOES 8 and 10 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.

Proton plot contains the five minute averaged integral proton flux (protons/cm²-sec-sr) as measured by GOES-8 (W75) 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.

