

**Space Weather Highlights**  
**19-25 April 1999**

Solar activity ranged from very low to low levels. The disk was populated by small, simple sunspot groups, a few of which produced isolated B- and C-class subflares. A large coronal mass ejection (CME) occurred around midday on 24 April. Space-based images indicated that the CME was a "back side" event, i.e. originating on the backside of the Sun, directed away from Earth. A solar proton event was associated with the CME (see the discussion below). It appeared that old Region 8517 (N22, L = 210, class/area Dso/100 on 20 April), two and a half days behind the west limb at the time, may have been the source of the CME.

Real-time solar wind data were available from the Advanced Composition Explorer (ACE) spacecraft for most of the period. Solar wind velocities, proton temperatures, and IMF Bz variations increased during 19 - 20 April, likely in response to an isolated, positive-polarity coronal hole.

A greater than 10 MeV solar proton event at geo-synchronous altitude was associated with the CME mentioned above. It began at 24/1840UT, reached a maximum of 32 PFU at 25/0055UT, then dropped below event threshold at 25/1450UT, followed by a gradual decline to pre-event levels.

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

The geomagnetic field was disturbed during 20 April with active to major storm levels (the major storm periods were limited to high latitudes). The disturbance appeared to be coronal-hole related. Quiet conditions prevailed during the rest of the period.

**Space Weather Outlook**  
**28 April - 24 May 1999**

Solar activity is expected to be at low to moderate levels. An increasing trend is expected to begin around 30 April with the return of historically active longitudes.

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

The greater than 2 MeV electron flux at geo-synchronous altitude may reach high levels around 30 April - 04 May. Otherwise, normal to moderate levels are expected.

Geomagnetic field activity is expected to increase to active to minor storm levels during 29 April - 02 May due to recurrent coronal hole effects. Quiet to unsettled conditions are expected during the rest of the period, barring any Earth-directed CMEs.



**Daily Solar Data**

Date	Radio Flux 10.7 cm	Sun spot No. (10 <sup>6</sup> hemi.)	Sunspot Area (10 <sup>6</sup> hemi.)	X-ray Background	Flares							
					X-ray Flux			Optical				
					C	M	X	S	1	2	3	4
19 April	110	90	270	B2.3	0	0	0	2	0	0	0	0
20 April	105	79	310	B2.1	0	0	0	4	0	0	0	0
21 April	103	79	280	B2.0	2	0	0	10	0	0	0	0
22 April	100	62	240	B3.6	2	0	0	0	0	0	0	0
23 April	98	71	230	B1.6	0	0	0	0	0	0	0	0
24 April	101	89	160	B1.4	0	0	0	4	0	0	0	0
25 April	103	69	270	B1.7	0	0	0	2	0	0	0	0

**Daily Particle Data**

Date	Proton Fluence (protons/cm <sup>2</sup> -day-sr)			Electron Fluence (electrons/cm <sup>2</sup> -day-sr)		
	>1MeV	>10MeV	>100MeV	>.6MeV	>2MeV	>4MeV
19 April	5.3E+4	1.4E+4	2.9E+3		3.5E+5	
20 April	3.3E+5	1.4E+4	3.0E+3		4.5E+6	
21 April	1.3E+5	1.2E+4	2.8E+3		1.6E+7	
22 April	1.1E+5	1.3E+4	2.8E+3		3.8E+7	
23 April	9.3E+4	1.3E+4	2.8E+3		3.9E+7	
24 April	1.9E+6	4.5E+5	3.3E+3		1.6E+7	
25 April	9.0E+6	9.7E+5	3.6E+3		2.5E+7	

**Daily Geomagnetic Data**

Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
19 April	10	0-1-2-4-2-2-3-3	*	*-1-3-6-5-4-2-3	13	0-1-3-4-3-3-3-3
20 April	15	4-2-3-3-3-3-3-2	41	3-4-4-6-6-6-3-1	21	4-4-4-4-4-4-3-2
21 April	9	2-2-3-2-2-3-2-1	25	3-2-3-5-5-5-3-1	12	2-1-3-4-3-3-3-2
22 April	2	2-1-1-0-0-0-1-1	*	2-*-0-*-0-1-2-1	4	1-1-1-0-0-2-2-1
23 April	4	1-1-1-1-2-2-1-1	4	1-2-1-2-2-1-0-1	5	1-0-1-1-2-2-2-1
24 April	5	2-3-1-1-1-1-1-0	4	2-2-1-2-1-1-1-0	7	3-2-2-2-1-3-2-1
25 April	5	0-0-2-1-2-1-2-3	5	0-0-2-4-1-1-0-1	5	1-0-1-1-2-2-1-3

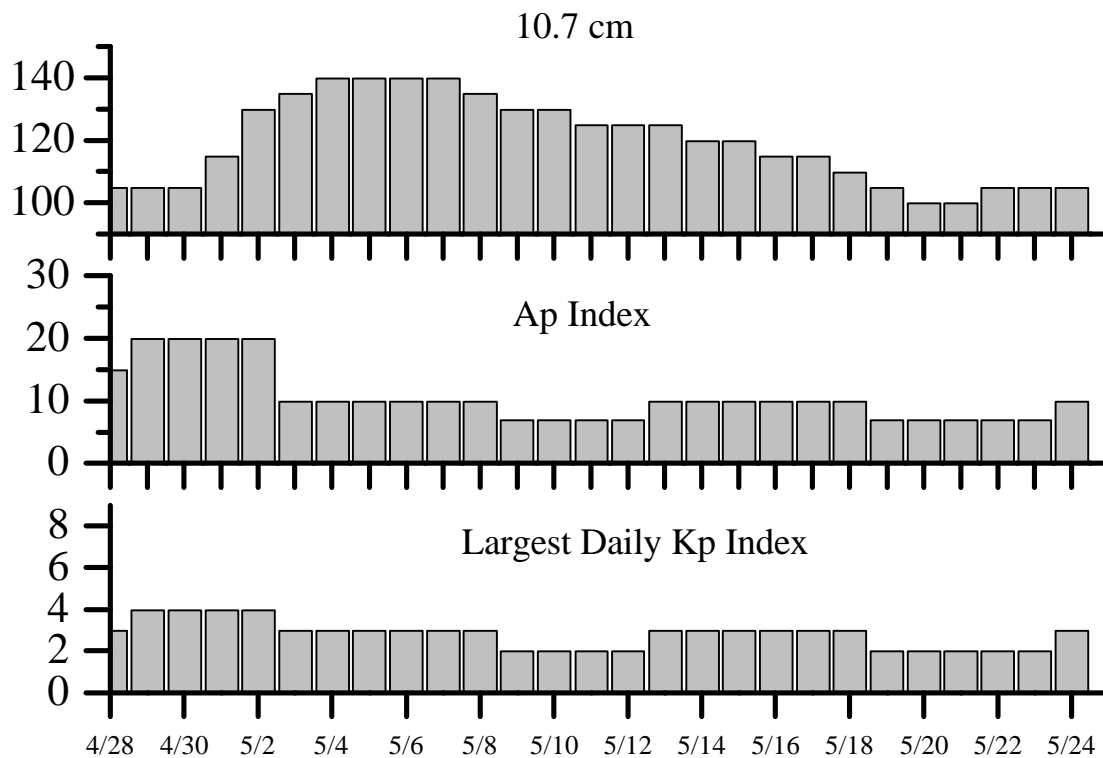


***Alerts and Warnings Issued***

<u>Date and Time of Issue (UT)</u>	<u>Type of Alert or Warning</u>	<u>Date and Time of Event (UT)</u>
19 Apr 0053	1 - 245 Radio Burst	18 Apr
19 Apr 1203	K= 4 Observed	19 Apr 09 - 12
19 Apr 1544	A $\geq$ 20 Watch	20 Apr
20 Apr 0305	K= 4 Observed 2	20 Apr 00 - 03
20 Apr 0900	K= 4 Observed	20 Apr 06 - 09
20 Apr 0918	K= 4 Observed	20 Apr 06 - 09
20 Apr 0918	K= 4 Warning valid	20 Apr 09 - 15
20 Apr 1817	K= 5 Observed	20 Apr 15 - 18
20 Apr 1822	A $\geq$ 20 Observed	20 Apr 1800
20 Apr 1827	K= 4 Warning valid	20/1800 -21/1500
22 Apr 0045	2-245 Radio Bursts	21 Apr
22 Apr 0045	1 - 245 Radio Noise Storm	21 Apr
24 Apr 0050	1 - 245 Radio Burst	23 Apr
24 Apr 1742	Proton Event >10MeV @ $\geq$ 10pfu Warning	24/1800 - 25/0600
24 Apr 1856	Proton Event >10MeV @ $\geq$ 10pfu	24 Apr 1840
25 Apr 1207	Proton Event >10MeV @ $\geq$ 10pfu CONTINUED	24 Apr 1840
25 Apr 1453	Proton Event >10MeV @ $\geq$ 10pfu ENDED	24 Apr 1840



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
28 Apr	105	15	3	12 May	125	7	2
29	105	20	4	13	125	10	3
30	105	20	4	14	120	10	3
01 May	115	20	4	15	120	10	3
02	130	20	4	16	115	10	3
03	135	10	3	17	115	10	3
04	140	10	3	18	110	10	3
05	140	10	3	19	105	7	2
06	140	10	3	20	100	7	2
07	140	10	3	21	100	7	2
08	135	10	3	22	105	7	2
09	130	7	2	23	105	7	2
10	130	7	2	24	105	10	3
11	125	7	2				



### *Energetic Events*

Date	Time (UT)		X-ray Integ	Optical Information			Peak		Sweep Freq	
	Begin	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.	Imp / Brtns	Optical Location Lat CMD	Rgn #
	Begin	Max	End				
19 April	0600	0619	0641	B6.3			
	1512	1512	1516		SF	S15E47	8518
	1634	1635	1639		SF	S15E46	8518
	1813	1822	1829	B8.0			
	2045	2050	2059	B3.7			
	2339	2350	0003	B7.9			
20 April	0145	0146	0150	B9.7	SF	S15E41	8518
	0259	0303	0306	B3.7			
	0752	0755	0805	B2.2			
	1139	1141	1146		SF	N21W67	8517
	1149	1155	1158		SF	N22W73	8517
	1258	1309	1323	B5.5			
	1721	1721	1734		SF	N21W79	8517
21 April	2333	2342	2356	B7.8			
	0019	0021	0028	B5.8	SF	N25W80	8517
	0147	0147	0152		SF	N25W79	8517
	0211	0217	0234	B6.4			
	0304	0309	0313	C1.7			
	0432	0441	0449	B4.4			
	0549	0552	0556	B2.8			
	0605	0606	0608	B3.6	SF	N24W83	8517
	0621	0716	0734	C1.1			
	0753	0754	0802		SF	S20W16	8516
	0811	0811	0816		SF	N24W88	8517
	1051	1055	1100	B8.2			
	1152	1155	1159	B5.8	SF	N34W29	8521
	1226	1232	1237		SF	N34W29	8521
	1251	1259	1306		SF	N33W30	8521
	1334	1334	1342		SF	N34W30	8521
	1403	1407	1411	B7.4			
	1647	1649	1652	B4.7	SF	N21W88	8517
1914	1918	1925	B4.1				
1958	2002	2007	B3.5				
2214	2219	2223	B8.4				



**Flare List-continued**

Date	Time			X-ray Class.	Optical		Rgn #
	Begin	Max	End		Imp / Brtns	Location Lat CMD	
22 April	0021	0029	0041	C1.5			
	0458	0509	0519	C4.5			
23 April	0247	0253	0259	B3.3			
	0638	0645	0649	B2.0			
	0912	0916	0925	B2.2			
	1031	1036	1039	B2.5			
	1613	1618	1626	B2.5			
	2242	2249	2300	B6.3			
24 April	0547	0556	0600	B2.2			
	1103	1106	1108	B2.0			
	1414	1415	1422	B3.1	SF	N17E58	8522
	1814	1814	1826	B3.4	SF	N16E55	8522
	1851	1852	1857		SF	N16E56	8522
	1910	1912	1917		SF	N16E53	8522
25 April	0750	0751	0758	B5.9	SF	N30E39	8523
	0924	0930	0942	B4.5			
	1229	1230	1237	B5.2	SF	N22E46	8524
	1626	1633	1642	B2.0			

**Region Summary**

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

*Region 8512*

08 Apr	S27E52	242	0010	05	BXO	004	B								
09 Apr	S28E38	243	0060	04	CSO	006	B								
10 Apr	S27E25	243	0060	06	DAO	007	B								
11 Apr	S27E12	243	0050	06	DAO	006	B								
12 Apr	S28W02	244	0030	06	CSO	005	B								
13 Apr	S27W17	245	0030	04	CSO	006	B								
14 Apr	S27W31	246	0030	02	CAO	003	B							1	
15 Apr	S27W44	246	0000	00	AXX	001	A								
16 Apr	S27W55	244	0000	00	AXX	001	A								
17 Apr	S24W69	245	0010	01	HSX	001	A							1	
18 Apr	S27W82	244	0010	00	AXX	001	A								
19 Apr	S27W95	244													

0 0 0 2 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 244



**Region Summary-continued**

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

*Region 8513*

09 Apr	S18E49	232	0020	09	BXO	003	B										
10 Apr	S18E35	233	0090	07	DAO	012	B										
11 Apr	S18E21	234	0070	07	DSO	014	B										
12 Apr	S18E09	233	0060	08	DAO	018	B										
13 Apr	S18W05	233	0060	07	DAO	013	B										
14 Apr	S15W20	235	0040	07	CAO	008	B										
15 Apr	S17W34	236	0010	02	BXO	004	B										
16 Apr	S18W44	233	0010	01	AXX	002	A										
17 Apr	S18W57	233															
18 Apr	S18W70	233															
19 Apr	S18W83	233															
20 Apr	S18W96	233															

0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 233

*Region 8514*

12 Apr	S33E08	234	0030	06	BXO	010	B										
13 Apr	S33W06	234	0040	06	CAO	011	B										
14 Apr	S34W24	239	0030	08	CAO	008	B										
15 Apr	S33W33	235	0020	06	BXO	007	B										
16 Apr	S32W47	236	0030	03	CSO	003	B										
17 Apr	S30W58	234	0080	11	EAO	009	B										3
18 Apr	S33W69	231	0030	11	BXO	006	B										
19 Apr	S31W85	234	0010	00	AXX	001	A										
20 Apr	S31W98	234															

0 0 0 3 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 234

*Region 8515*

13 Apr	S20E06	222	0020	04	BXO	009	B	1									1
14 Apr	S11W10	225	0010	05	BXO	008	B										1
15 Apr	S18W20	222	0040	05	CAO	014	B										
16 Apr	S16W31	220	0070	06	DAO	009	B										
17 Apr	S16W44	220	0030	08	DAO	008	B										
18 Apr	S18W56	218	0010	07	BXO	005	B										
19 Apr	S18W69	218															
20 Apr	S18W82	218															

1 0 0 1 1 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 222



**Region Summary-continued**

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

*Region 8516*

14 Apr	S21E68	147	0060	09	CAO	005	B										
15 Apr	S19E55	147	0050	09	CAO	008	B										
16 Apr	S20E44	145	0070	08	CAO	008	B										
17 Apr	S20E30	146	0080	09	CAO	005	B										
18 Apr	S18E16	146	0060	06	CSO	005	B										
19 Apr	S18E03	146	0070	06	CAO	005	B										
20 Apr	S19W11	147	0040	05	CSO	003	B										
21 Apr	S19W25	148	0050	04	CSO	003	B										1
22 Apr	S20W36	146	0040	08	CSO	006	B										
23 Apr	S19W50	147	0030	06	CRO	008	B										
24 Apr	S19W62	145	0020	08	CRO	010	B										
25 Apr	S19W75	145															

0 0 0 1 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 146

*Region 8517*

16 Apr	N20W21	210	0020	03	BXO	004	B										
17 Apr	N22W36	212	0030	07	CSO	003	B										
18 Apr	N22W51	213	0030	07	CRO	006	B										1
19 Apr	N22W63	212	0070	09	DSO	005	B										
20 Apr	N22W77	213	0100	09	DSO	003	B										3
21 Apr	N24W88	211	0040	02	HSX	001	A										5

0 0 0 9 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 210

*Region 8518*

17 Apr	S16E66	110	0060	02	HAX	002	A										
18 Apr	S14E53	109	0080	02	HAX	004	A										
19 Apr	S14E40	109	0100	07	CAO	011	B										2
20 Apr	S15E29	107	0160	08	DAO	016	B										1
21 Apr	S15E15	108	0160	08	DAO	017	B										
22 Apr	S15E04	106	0170	11	EAO	018	B										
23 Apr	S14W10	107	0160	09	DAO	018	B										
24 Apr	S14W23	106	0120	08	CAO	009	B										
25 Apr	S13W38	108	0080	04	CAO	008	B										

0 0 0 3 0 0 0 0

Still on Disk.

Absolute heliographic longitude: 106







***Region Summary-continued***

Location		Sunspot Characteristics					Flares							
Date	( ° Lat ° CMD)	Helio Lon	Area (10 <sup>-6</sup> hemi)	Extent (helio)	Spot Class	Spot Count	Mag Class	X-ray			Optical			
							C	M	X	S	1	2	3	4
<i>Region 8523</i>														
24 Apr	N32E42	041	0000	07	BXO	003	B							
25 Apr	N31E28	042	0010	04	BXO	004	B				1			
											0	0	0	0
Still on Disk.														
Absolute heliographic longitude: 042														
<i>Region 8524</i>														
24 Apr	N22E53	030	0000	00	AXX	001	A							
25 Apr	N22E39	031	0120	06	DSO	008	B				1			
											0	0	0	0
Still on Disk.														
Absolute heliographic longitude: 031														



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

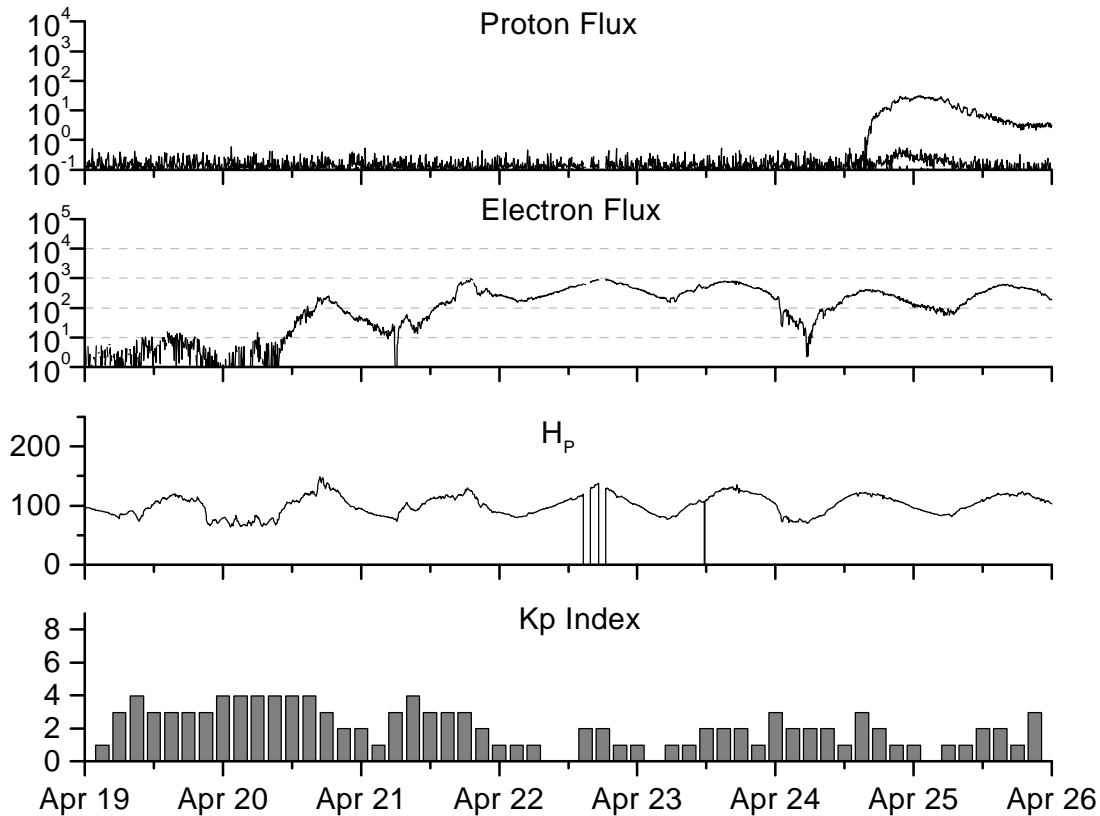
Month	Sunspot Numbers			Radio Flux		Geomagnetic			
	Observed values SWO	Ratio RI	Ratio RI/SWO	Smooth values SWO	Smooth values RI	**Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
<b>1997</b>									
April	24.5	15.5	0.63	24.0	16.5	74.5	76.8	10	08.6
May	28.6	18.5	0.65	26.4	18.3	74.6	78.4	08	08.6
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
<b>1998</b>									
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	11.1
April	73.6	53.4	0.73	77.7	56.5	108.3	109.1	10	11.3
May	74.3	56.3	0.76	81.4	59.3	106.7	112.4	18	11.6
June	93.6	70.7	0.76	85.9	62.4	108.4	116.2	10	11.9
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	12.4
September	119.0	92.9	0.78			138.4		14	12.5
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	
<b>1999</b>									
January	94.3	62.4	0.66			142.6		10	
February	93.4	66.1	0.70			142.0		11	
March	100.5	69.1	0.70			126.3		13	

**NOTE:** All smoothed values after January 1998 and monthly values after September 1998 are 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.

\* After June 1991, 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 19 April 1999*

*Protons* plot contains the five-minute averaged integral proton flux (protons/ cm<sup>2</sup>-sec-sr) as measured by GOES-8 (W75) for each of three energy thresholds: greater than 10, 50, and 100 MeV.

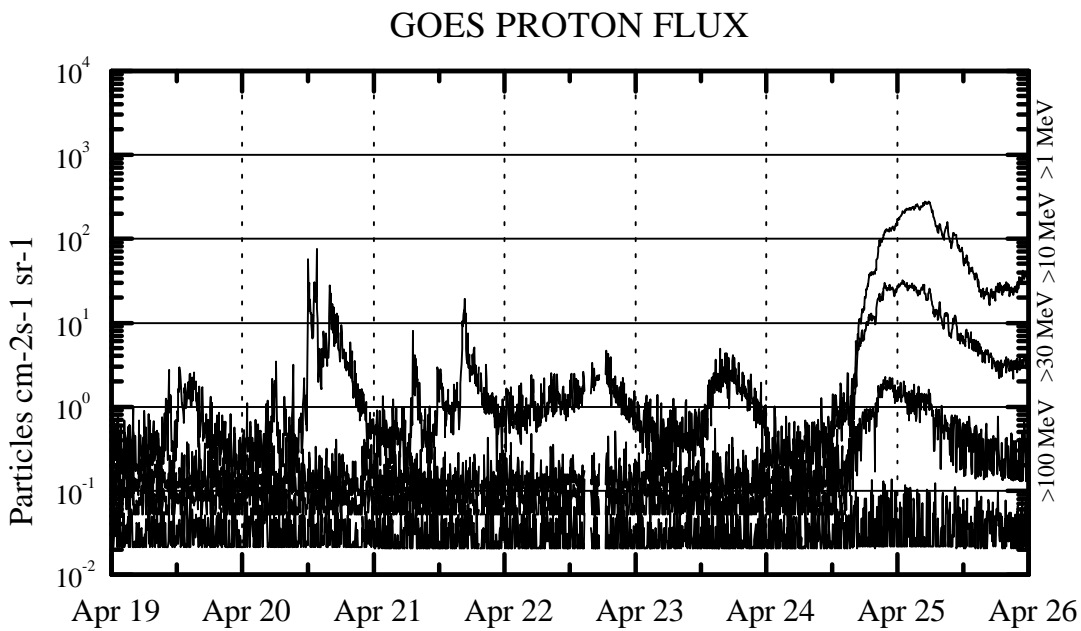
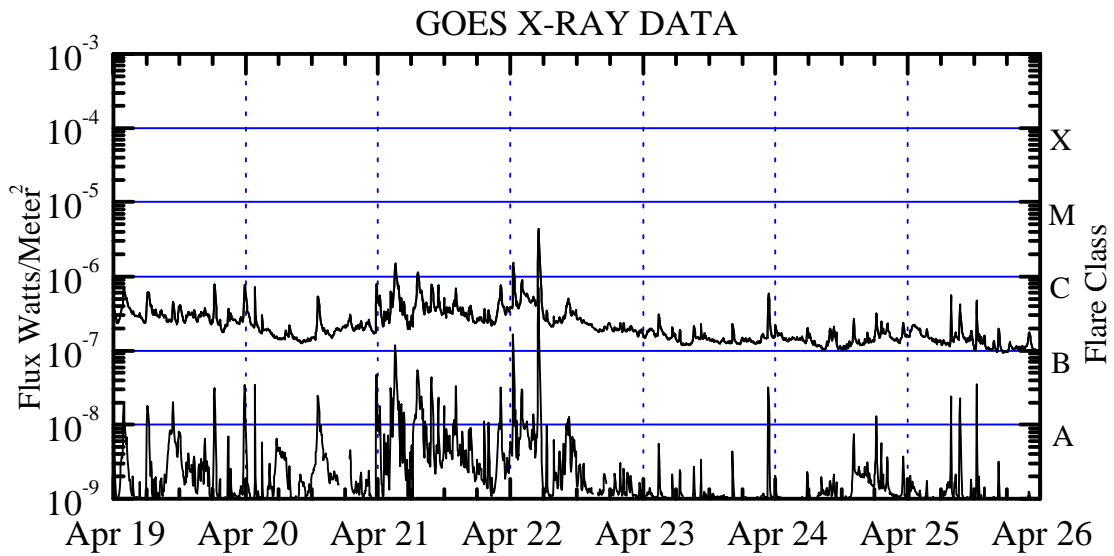
*Electrons* plot contains the five-minute averaged integral electron flux (electrons/ cm<sup>2</sup> -sec-sr) with energies greater than 2 MeV at GOES-8.

*H<sub>p</sub>* 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<sub>p</sub>* plot contains the estimated planetary 3-hour K-index (derived by the USAF 55<sup>th</sup> 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<sub>p</sub> 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<sub>p</sub> are “ global ” parameters that are applicable to a first order approximation over large areas. H<sub>p</sub> 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/m<sup>2</sup>) 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/cm<sup>2</sup>-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/cm<sup>2</sup>-sec-sr) at greater than 10 MeV.

