

**Space Weather Highlights**  
**11-17 May 1998**

Solar activity was very low to low. Region 8218 (S21, L = 346, class/area Eac/270 on 16 May) generated several small C-class events throughout the period, while region 8220 (S28, L = 283, class/area Dao/120 on 13 May) was responsible for a couple of additional minor C-class flares.

Solar wind data were available from the ACE spacecraft during most of the period. Velocities rapidly increased from 350-650 km/sec on 15-16 May following an interplanetary shock passage at 15/1356UT, then gradually decreased to 420 km/sec on 17 May. Solar wind particle densities increased to 20 p/cc on 15 May, then declined to a range of 1-3 p/cc for the rest of the period. BZ hovered about zero for most of the period 11-15 May, before displaying wide variability in the range +9 to -13 nT following the shock passage on 16 May. Bz ranged from +5 to -5 nT on 17 May.

There were no significant proton enhancements observed at geosynchronous altitude.

The greater than 2 MeV electron flux at geosynchronous altitude was moderate to high during the period 11-13 May, mostly high on 14-15 May, and back in the moderate to high range on 16-17 May.

The geomagnetic field was mostly quiet to unsettled throughout the period, with occasional isolated periods of active conditions. A small sudden impulse was detected on ground magnetometers (about 6 nT on the Boulder USGS magnetometer) at 15/1453, apparently in response to the passage of the interplanetary shock mentioned above.

**Space Weather Forecast**  
**20 May -15 June 1998**

Solar activity is expected to range from very low to moderate. M-class flares are forecast during 21 May - 05 June due to the expected return of old Regions 8210 and 8214, which combined generated nine M-class and two X-class events during their previous rotations.

Chances for solar proton events are expected to increase during 26 May - 05 June, given the expected return of these two regions.

The greater than 2 MeV electron flux at geosynchronous altitude is expected to be at moderate to high levels during 23-26 May. Fluxes are expected to be normal to moderate during the rest of the period.

The geomagnetic field is expected to be at unsettled to active levels during 22-24 May due to recurrent coronal hole effects. Quiet to unsettled conditions are expected during the rest of the period.



### Daily Solar Data

Date	Radio	Sun	Sunspot	X-ray	Flares				Optical			
	Flux 10.7 cm	spot No. ( $10^6$ hemi.)	Area	Background	X-ray Flux			S	1	2	3	4
					C	M	X					
11 May	108	72	430	B3.1	0	0	0	3	1	0	0	0
12 May	112	90	460	B3.3	2	0	0	4	0	0	0	0
13 May	117	90	490	B2.8	2	0	0	7	0	0	0	0
14 May	117	94	440	B3.2	3	0	0	9	0	0	0	0
15 May	116	101	420	B4.4	2	0	0	2	0	0	0	0
16 May	118	92	500	B5.3	3	0	0	4	0	0	0	0
17 May	110	89	550	B3.1	0	0	0	0	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
11 May	2.1E+6	3.5E+4	5.5E+3		3.9E+8	
12 May	8.5E+5	1.9E+4	5.4E+3		1.8E+8	
13 May	4.9E+5	1.8E+4	5.5E+3		2.3E+8	
14 May	5.2E+5	1.8E+4	5.5E+3		2.7E+8	
15 May	1.9E+6	1.7E+4	5.5E+3		3.2E+8	
16 May	1.9E+6	1.7E+4	4.5E+3		6.5E+7	
17 May	1.8E+6	1.7E+4	4.4E+3		4.2E+7	

### Daily Geomagnetic Data

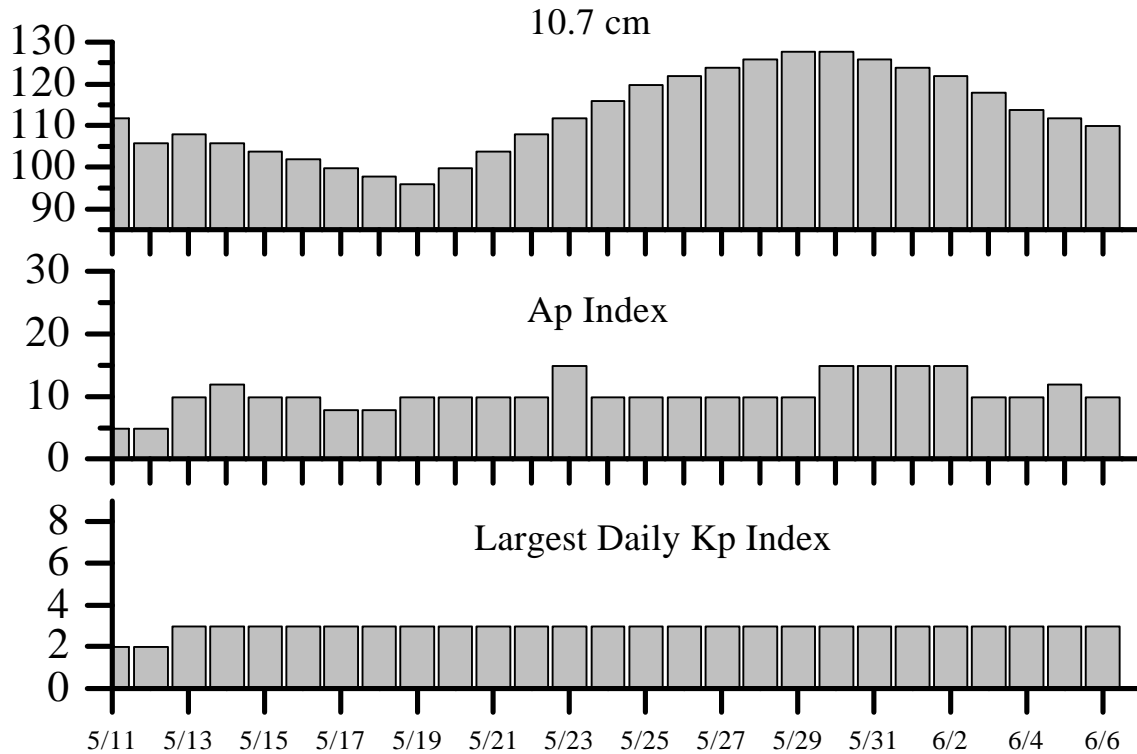
Date	Middle Latitude Fredericksburg		High Latitude College		Estimated Planetary	
	A	K-indices	A	K-indices	A	K-indices
11 May	8	2-2-3-2-1-2-2-3	16	2-2-4-5-3-2-2-2	13	3-3-3-3-1-3-3-4
12 May	14	3-4-4-3-2-1-3-2	*	3-*-6-*-5-2-*-1	19	4-4-4-4-3-3-3-3
13 May	4	1-1-2-0-2-1-1-1	*	2-*-*-*-*-1-1	6	2-1-3-1-2-2-1-1
14 May	3	1-1-2-1-1-1-0-1	2	1-2-1-0-1-0-0-1	5	1-1-2-1-2-2-2-1
15 May	5	1-0-0-0-2-2-2-3	3	1-0-0-0-1-1-2-2	8	1-0-1-1-3-3-3-3
16 May	*	2-3-2-1-2-2-*-*	*	2-2-1-1-2-2-*-*	12	2-3-2-1-3-3-4-3
17 May	10	4-2-2-1-3-3-1-2	7	3-3-1-0-2-2-1-2	9	4-2-2-1-3-3-2-3

### Alerts and Warnings Issued

Date and Time of Issue (UT)	Type of Alert or Warning	Date and Time of Event (UT)
12 May 0000	K= 4 Observed	11 May 21 - 24
15 May 1530	Sudden Impulse 6nT at Boulder	15 May 14:53
17 May 0300	K =4 Observed	17 May 00- 03



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
20 May	100	10	3	03 June	118	10	3
21	104	10	3	04	114	10	3
22	108	10	3	05	112	12	3
23	112	15	3	06	110	10	3
24	116	10	3	07	108	10	3
25	120	10	3	08	108	10	3
26	122	10	3	09	106	12	3
27	124	10	3	10	104	10	3
28	126	10	3	11	102	8	3
29	128	10	3	12	100	8	3
30	128	15	3	13	100	10	3
31	126	15	3	14	98	10	3
01 June	124	15	3	15	98	10	3
02	122	15	3				



**Energetic Events**

Date	Time (UT)		X-ray		Optical Information			Peak		Sweep Freq		
	Begin	Max	½ Max	Class	Integ Flux	Imp Brtns	Location		Radio Flux		Intensity	
							Lat	CMD	#	245	2695	II

**No events observed**

**Flare List**

Date	Time			X-ray Class.	Optical		Rgn #
	Begin	Max	End		Imp / Brtns	Location Lat CMD	
11 May	0854	0903	0910	B6.9			
	1037	1047	1110	B9.6	1F	S22E05	8218
	1254	1317	1334	B8.4			
	1858	1902	1914	B5.6	SF	S22E02	8218
	2148	2153	2159	B6.6			
	2234	2235	2241		SF	S20E01	8218
	2342	2343	2351	B7.7	SF	S21E01	8218
12 May	0507	0546	0637	C1.2	SF	S20E02	8218
	0815	0818	0833		SF	S24W02	8218
	1842	1846	1850	C1.0			
	2157	2200	2204		SF	S22W06	8218
13 May	2312	2312	2317	B4.9	SF	S21W06	8218
	0202	0206	0210	B4.8			
	0624	0627	0635		SF	S22W18	8218
	1326	1330	1332	B4.6			
	1400	1402	1406		SF	S26W17	8218
	1451	1452	1501	C1.1	SF	S22W16	8218
	1753	1756	1758	B3.5			
	1845	1846	1852	B7.0	SF	S21W18	8218
	2044	2045	2051	B4.2	SF	S18W25	8218
	2126	2130	2133		SF	S20W16	8218
14 May	2224	2225	2230	C1.6	SF	S20W18	8218
	2234	2237	2241	B8.5			
	0017	0017	0046	B7.9	SF	S20W19	8218
	0051	0055	0103	B5.4			
	0154	0158	0202	B8.2			
	0232	0236	0240	B5.3			
	0257	0301	0304	B5.9			
	0618	0619	0625		SF	N23E46	8222
	0642	0732	0744		SF	S20W24	8218
	0754	0755	0803	B9.1	SF	N23E45	8222
	0829	0832	0837		SF	S20W21	8218
	1030	1036	1043	C1.5	SF	S22W26	8218
	1252	1252	1259		SF	S21W25	8218
	1334	1338	1341	B5.1			
	1347	1348	1411	C2.4	SF	S26E38	8220
1655	1704	1709	C1.2				



*Flare List – continued.*

Date	Time			X-ray Class.	Imp / Brtns	Optical		Rgn #
	Begin	Max	End			Location Lat CMD		
14 May	1856	1900	1913	B9.8				
	B2026	2029	2032	B5.5	SF	S21W31	8218	
	2157	2209	2252	B4.9				
15 May	0121	0128	0142	B8.8				
	0220	0222	A0223	C1.8	SF	S19W41	8218	
	1002	1009	1015	C1.7				
16 May	1536	1536	1548		SF	S19W41	8218	
	0155	0157	0204	C2.2	SF	S21W44	8218	
	0428	0432	0448	C1.6	SF	S21W45	8218	
	0444	0445	0449		SF	N21E20	8222	
	0744	0747	0750	B5.3				
	1030	1036	1040	B9.3				
	1549	1556	1601	C1.1				
	1629	1634	1638	B9.9				
	1807	1823	1852	B6.2				
17 May	2028	2035	2041		SF	S17W58	8218	
	0240	0243	0246	B6.4				
	0438	0442	0444	B5.7				
	0859	0920	0941	B9.5				

*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	2	3	4			
<i>Region 8214</i>																		
29 Apr	N28E60	097	0000	00	AXX	001	A											
30 Apr	N26E47	095	0040	05	CRO	009	B					6						
01 May	N26E33	095	0140	09	DAI	028	BG	1	1			10	1					
02 May	N27E19	096	0200	10	EAI	027	B	2				5	1					
03 May	N27E06	096	0300	13	ESC	050	B	1	1			8						
04 May	N27W08	097	0510	14	EKI	060	B	2				4	1					
05 May	N27W23	099	0650	17	FKC	052	BG	3				12	1					
06 May	N27W34	096	0620	17	FHC	043	B	1				11						
07 May	N27W48	097	0620	18	FKC	031	B	3	2			5	2					
08 May	N28W61	097	0380	18	FKI	021	B	2				2	1					
09 May	N27W74	096	0240	16	CHO	006	B	2				1		1				
10 May	N26W84	093	0090	13	CSO	005	B											
								17	4	0	64	7	1	0	0			

Crossed West Limb.

Absolute heliographic longitude: 96



**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	4						
<i>Region 8216</i>																					
30 Apr	S21E51	091	0000	00	AXX	001	A														
01 May	S22E38	090	0010	00	AXX	001	A														
02 May	S21E25	090	0000	00	AXX	001	A														
03 May	S22E12	090	0000	01	AXX	002	A														
04 May	S22E00	089	0000	01	AXX	002	A														
05 May	S22W13	089	0000	01	AXX	002	A														
06 May	S22W26	089																			
07 May	S22W39	089																			
08 May	S22W52	089																			
09 May	S22W65	089																			
10 May	S22W78	089																			

0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 089

<i>Region 8217</i>																				
02 May	S17E74	041	0040	01	HSX	002	A													
03 May	S16E60	042	0060	02	HSX	001	A													
04 May	S16E47	042	0040	02	HSX	001	A													
05 May	S15E34	042	0040	01	HSX	001	A													
06 May	S17E21	041	0040	02	HSX	001	A													
07 May	S17E09	040	0050	02	HSX	001	A													
08 May	S16W05	041	0040	01	HSX	001	A													
09 May	S16W18	040	0030	02	HSX	001	A													
10 May	S16W31	040	0030	01	HSX	001	A													
11 May	S16W44	040	0040	01	HSX	001	A													
12 May	S16W57	039	0050	01	HSX	001	A													
13 May	S16W71	040	0040	01	HSX	001	A													
14 May	S17W86	042	0020	01	AXX	001	A													

0 0 0 0 0 0 0 0

Crossed West Limb.

Absolute heliographic longitude: 41



### 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	4		
<i>Region 8218</i>																	
06 May	S23E74	348	0010	01	AXX	002	A					3					
07 May	S22E61	348	0160	08	DSO	005	B	1	1			12					
08 May	S20E48	348	0190	10	DKI	016	B										
09 May	S19E34	348	0260	12	EAI	019	B										
10 May	S20E22	347	0220	11	ESO	014	B										
11 May	S20E08	348	0230	11	ESO	012	B					3	1				
12 May	S20W05	347	0210	12	EAI	024	B	1				4					
13 May	S20W18	347	0210	13	ESI	026	B	2				7					
14 May	S21W31	347	0180	12	ESI	024	B	1				6					
15 May	S21W45	348	0200	13	ESI	025	B	1				2					
16 May	S21W57	346	0270	14	EAC	018	B	2				3					
17 May	S20W70	345	0350	14	ESC	015	B										
								8	1	0		40	1	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 347

<i>Region 8219</i>																	
08 May	N28E41	355	0010	03	BXO	003	B										
09 May	N28E28	355															
10 May	N28E15	355															
11 May	N28E02	355															
12 May	N28W11	355															
13 May	N28W24	353															
14 May	N28W37	353															
15 May	N28W50	353															
16 May	N28W63	353															
17 May	N28W76	353															
								0	0	0		0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 355



### Region Summary-continued

Location			Sunspot Characteristics					Flares															
Date	Helio		Area (10 <sup>6</sup> )	Extent hemi)	Spot (helio)	Spot Class	Mag Count	X-ray			Optical												
	(° Lat ° CMD)	Lon						Class	C	M	X	S	1	2	3	4							
<i>Region 8220</i>																							
10 May	S31E82	287	0200	02	HSX	001	A	1															
11 May	S26E68	288	0130	07	CSO	005	B																
12 May	S27E57	285	0120	09	DSO	009	B																
13 May	S28E46	283	0120	10	DAO	013	B																
14 May	S27E34	282	0090	11	ESO	012	B	1			1												
15 May	S27E20	283	0080	12	ESO	020	B																
16 May	S28E07	282	0050	12	ESI	023	B																
17 May	S27W07	282	0070	13	CRO	025	B																
								2	0	0	1	0	0	0	0	0	0	0	0	0	0		

Still on Disk.

Absolute heliographic longitude: 282

#### *Region 8221*

11 May	S09W46	042	0010	02	BXO	002	B														
12 May	S09W59	041	0000	00	AXX	001	A														
13 May	S09W72	041																			
14 May	S09W85	041																			
								0	0	0	0	0	0	0	0	0	0	0	0	0	0

Crossed West Limb.

Absolute heliographic longitude: 042

#### *Region 8222*

11 May	N20E68	288	0020	02	BXO	002	B														
12 May	N21E60	282	0080	10	DSO	005	B														
13 May	N22E48	281	0120	12	EAO	010	B														
14 May	N22E35	281	0150	12	EAI	017	BG				2										
15 May	N22E22	281	0140	12	EAO	026	B														
16 May	N22E09	280	0180	12	EAO	021	B				1										
17 May	N23W04	279	0130	12	EAO	019	B														
								0	0	0	3	0	0	0	0	0	0	0	0	0	0

Still on Disk.

Absolute heliographic longitude: 279





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

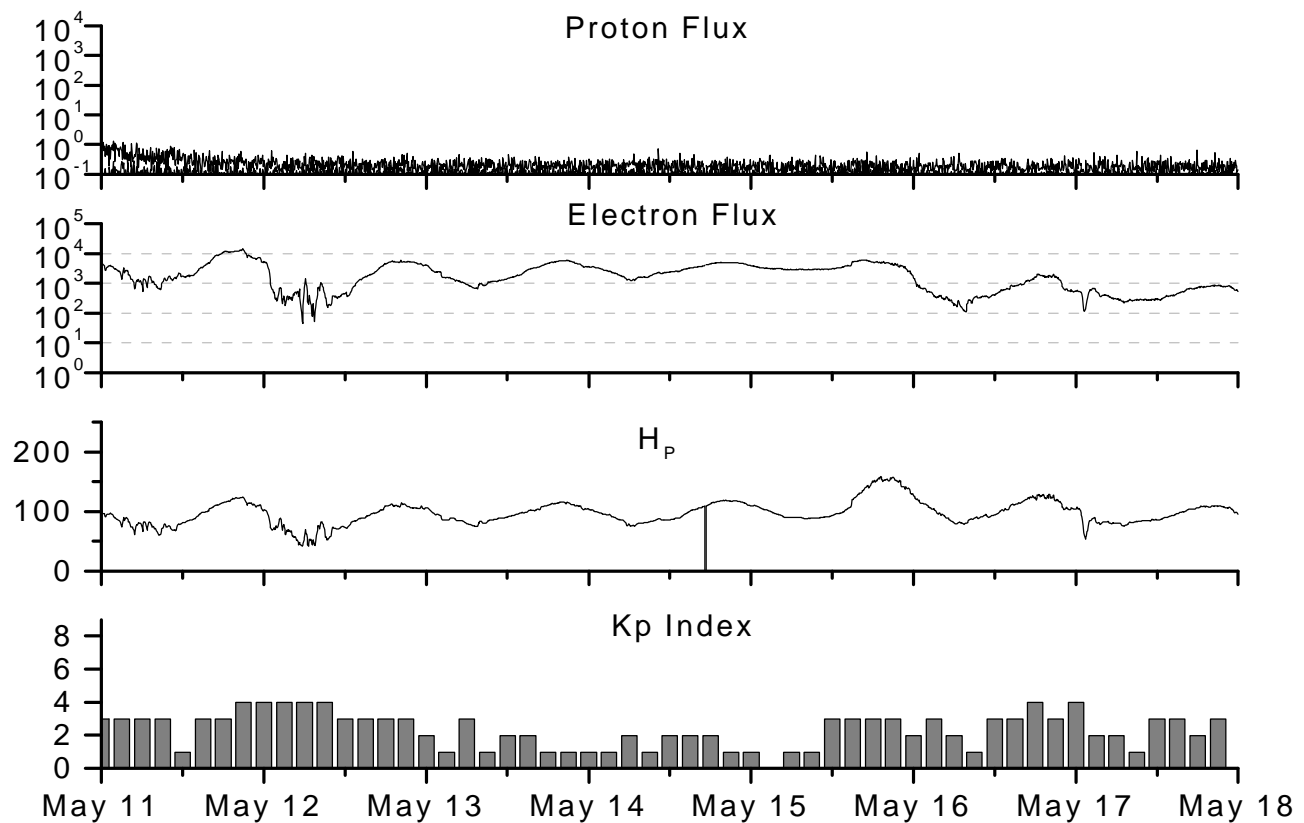
Month	Sunspot Numbers				Radio Flux		Geomagnetic		
	Observed SWO	values RI	Ratio RI/SWO	Smooth SWO	values RI	**Penticton 10.7 cm	Smooth Value	Planetary Ap	Smooth Value
<b>1996</b>									
May	11.8	05.5	0.47	12.9	08.0	72.1	71.4	07	09.5
June	18.8	11.8	0.63	13.5	08.5	69.6	71.8	05	09.4
July	13.2	08.2	0.62	13.4	08.4	71.2	72.0	07	09.3
August	20.5	14.4	0.70	13.1	08.3	72.4	72.1	09	09.4
September	02.9	01.6	0.55	13.3	08.4	69.4	72.3	15	09.3
October	02.3	00.9	0.39	14.0	08.8	69.2	72.6	13	09.1
November	26.7	17.9	0.67	15.4	09.8	78.7	73.0	08	09.1
December	21.1	13.3	0.63	16.2	10.4	77.8	73.3	07	09.3
<b>1997</b>									
January	09.0	05.7	0.63	16.5	10.5	74.0	73.4	09	09.3
February	11.3	07.6	0.67	17.4	11.0	73.8	73.7	11	09.2
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	08.7*
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	25.1*	79.0	83.4*	07	08.3*
September	52.8	51.3	0.88	40.5	28.4*	96.2	85.7*	10	08.2*
October	33.6	22.8	0.68	45.4	31.9*	84.9	88.6*	11	08.3*
November	53.5	39.0	0.73			99.5		11	
December	57.9	41.2	0.71			98.8		05*	
<b>1998</b>									
January	51.8	32.3*	0.62*			93.5*		07*	
February	54.4	40.7*	0.75*			93.6*		07*	
March	81.1	54.8*	0.67*			109.4*		11*	
April	73.6	53.3*	0.72*			108.3*		10*	

\*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 11 May 1998*

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

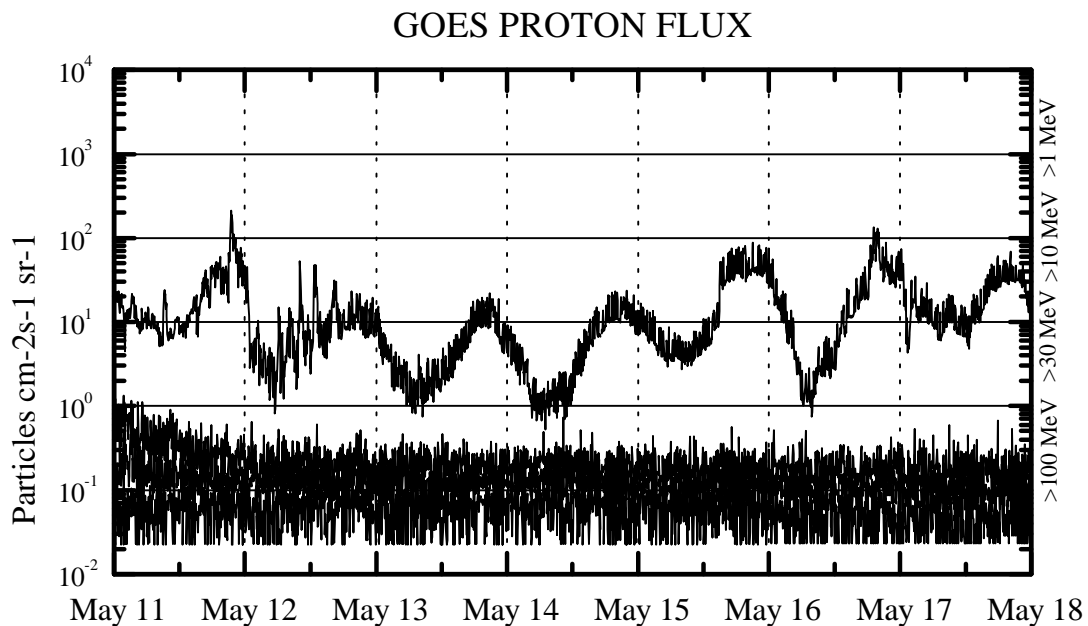
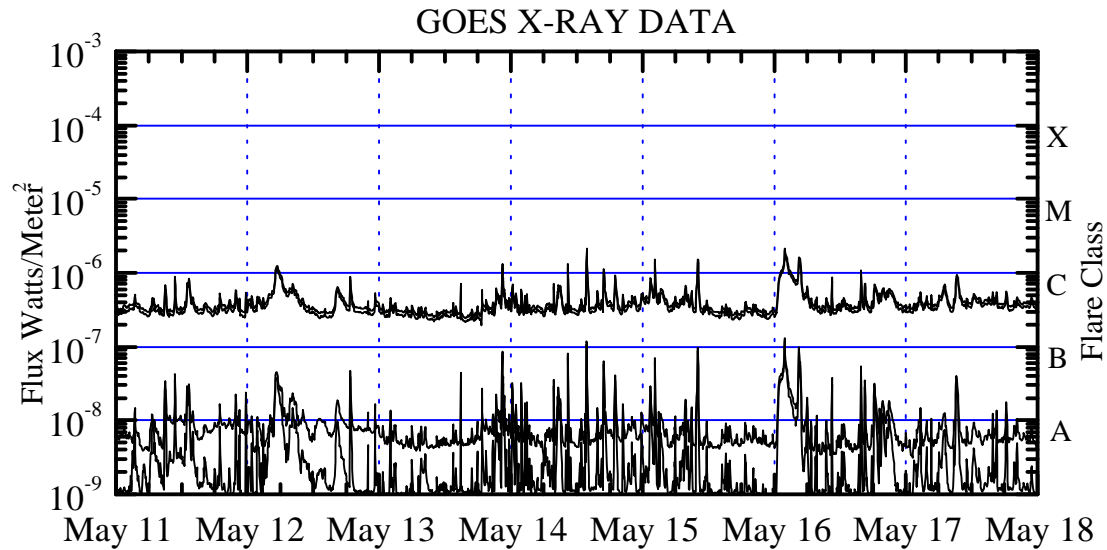
*Electrons* plot contains the five-minute averaged integral electron flux (electrons/ cm<sup>2</sup>-sec-sr) with energies greater than 2 MeV at GOES-9.

*H<sub>p</sub>* 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<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 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.

Proton plot contains the five minute averaged integral proton flux (protons/cm<sup>2</sup>-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/cm<sup>2</sup>-sec-sr) at greater than 10 MeV.

