Australian Government

Bureau of Meteorology

SPACE WEATHER SERVICES

SOLAR

AND

GEOPHYSICAL

SUMMARY

August 2023

Solar Activity

A total of 27 solar flares of magnitude R1-R3 were observed in August 2023. Solar activity was R3 on 05-Aug with an X1.6 solar flare at 05/2221 UT from AR3386 and also on 07-Aug with an X1.5 flare at 07/2046 UT from the same region. Neither of the X1 flares caused a significant shortwave fadeout in the Australian region. Sunspot region AR3386 was responsible for the R3 flares and also for several long duration R1 solar flares. Many of these flares were associated with halo CMEs; because the region was near the western solar limb during these events though, none of these CMEs had any significant impact. Some weak enhancements to solar wind parameters were observed from these events.

The most notable event for the month was a CME associated with an R1 flare and filament eruption on 02-Aug which arrived to Earth on 05-Aug. During this event the solar wind peaked at 579 km/s before falling to 350 km/s. The peak total interplanetary field strength (IMF, Bt) reached 24 nT and was associated with 20+ hours of southward Bz, causing favourable conditions for geomagnetic activity.

No other significant CMEs arrived at Earth during the month, however several weak glancing blows were observed on 01, 07, 10, 20 and 24 Aug. No significant coronal hole wind streams were observed during August, however there were several small coronal holes which may have briefly contributed to elevated solar wind speeds frequently during the month. Enhanced solar wind speeds were observed on 05, 07-08, 10, 18-22 Aug.

An R1 solar flare on 05-Aug caused an enhancement to the 10 MeV solar protons, and then the R3 solar flare on 05-Aug caused the 10 MeV protons to exceed the S1 threshold. A maximum of 18 pfu was observed before the event ended on 06-Aug. The R3 solar flare then caused the 10 MeV solar protons to increase again to S1 solar radiation storm conditions over 08-10 Aug and they reached a maximum of 47 pfu. Minor polar cap absorption was observed over 05-06 and 08-10 Aug due to S1 solar radiation storms.

M and X class flares for the month are listed below.

DATE	FLARES CLASS M	CLASS X	FLARE MAX	FADEOUT POSSIBLE ON DAYLIGHT CIRCUIT
01 Aug 23	M1.0/SF		0156UT	
01 Aug 23	M1.2		0203UT	
01 Aug 23	M2.2/1N		0447UT	
01 Aug 23	M1.3		0537UT	
01 Aug 23	M3.6		0657UT	0628-0719UT
01 Aug 23	M1.5/SF		0909UT	
01 Aug 23	M1.4/1N		1409UT	
01 Aug 23	M1.0		2151UT	
02 Aug 23	M1.3/1F		0812UT	
02 Aug 23	M1.2/1F		1050UT	
02 Aug 23	M1.7/SF		1452UT	
02 Aug 23	M1.3		1622UT	
02 Aug 23	M1.1		1914UT	
03 Aug 23	M2.0/SF		1155UT	
04 Aug 23	M1.9/1N		0424UT	
05 Aug 23	M1.6/1N		0718UT	
05 Aug 23	M2.1		0936UT	
05 Aug 23		X1.6/SN	2221UT	2145-2244UT
06 Aug 23	M5.5/SN		1840UT	1820-1854UT
07 Aug 23	M2.4		0441UT	
07 Aug 23	M1.0/SF		1627UT	
07 Aug 23	M1.4/2N		1951UT	
07 Aug 23		X1.5	2046UT	2030-2118UT
08 Aug 23	M3.6/SF		0931UT	0920-0941UT
22 Aug 23	M1.1		2304UT	
25 Aug 23	M1.4/1N		0109UT	
26 Aug 23	M1.1		2250UT	

FLARE ALERT	SWF ALERT
01 Aug 23	0438-0523 UT
02 Aug 23	
03 Aug 23	
04 Aug 23	
05 Aug 23	
06 Aug 23	
07 Aug 23	0435-0454 UT
08 Aug 23	
22 Aug 23	
25 Aug 23	
26 Aug 23	

PROTON ALERT

BEGIN DATE	BEGIN TIME	END DATE	END TIME	ENERGY THRESHOLD
05 08 2023	1105UT	05 08 2023	2000UT	10MeV (S1)
05 08 2023	2340UT	06 08 2023	0435UT	10MeV (S1)
08 08 2023	0105UT	10 08 2023	0915UT	10MeV (S1)

Ionospheric Activity

No significant ionospheric depressions were observed in the Australian region during the month of August. The regional ionosphere exhibited a positive ionospheric response to geomagnetic activity on 05-Aug, with enhanced conditions of 15-30% observed on 05-Aug during the local day. In the northern hemisphere an ionospheric depression response of 10 to 30% was observed on 05-Aug for middle to high latitudes.

In general, regional MUFs were near predicted values to 15% enhanced for most of the month and correspondingly the daily T index values were consistently higher than the monthly predicted T index value of 88 for the month of August.

Brief shortwave fadeouts impacting only lower HF frequencies were observed on 01-Aug and 07-Aug during local Australian morning hours. Transpolar HF circuits may have experienced increased absorption during 05-06 and 08-10 Aug due to S1-Minor solar proton events following long-duration solar flares on 05 and 07-Aug.

Mild depressions for high latitudes during local night hours were frequently observed. Degraded low latitude HF conditions, indicated by spread F in low latitude ionograms, were common during the predawn period for most of the month of August.

Scintillation was observed in low latitudes on 12, 14, 18, 25 and 31-Aug.

Ionosonde data was heavily restricted over 25-27 Aug due to an unplanned ionosonde outage.

Ionospheric depressions listed below are calculated using foF2 data from the ASWFC ionosonde network.

IONOSPHERIC DISTURBANCES (MUFs for the Australian region)

No significant ionospheric depressions were observed during the month.

RADIO COMMUNICATIONS WARNINGS

DATE	Nº.	BEGIN	END
01 Aug 23	73	01 Aug 23	03 Aug 23
04 Aug 23	74	04 Aug 23	06 Aug 23
05 Aug 23	75	05 Aug 23	06 Aug 23
05 Aug 23	76	06 Aug 23	08 Aug 23
07 Aug 23	77	08 Aug 23	09 Aug 23
08 Aug 23	78	09 Aug 23	11 Aug 23
11 Aug 23	79	11 Aug 23	13 Aug 23
17 Aug 23	80	17 Aug 23	19 Aug 23
22 Aug 23	81	23 Aug 23	24 Aug 23
25 Aug 23	82	25 Aug 23	26 Aug 23
28 Aug 23	83	29 Aug 23	31 Aug 23
31 Aug 23	84	03 Sep 23	04 Sep 23

Geomagnetic Activity

The strongest disturbance for the month of August was observed on 05-Aug with a local Australian A index of 18 reached. The SWPC Kp data reported a maximum Kp of 7 (G3) during this period, but the GFZ Kp data only reported a maximum of 6 (G2). Australian K indices only reported a maximum of 5 (G1). This activity was induced by a CME that left the Sun on 02-Aug. Several CMEs were observed during the month, but other than the event of 05-Aug no significant geomagnetic storms occurred. No significant coronal holes were observed during August, but there were several small coronal holes which may have contributed to elevated solar winds on 05, 07-08, 10, 18-22 Aug.

Disturbances with Australian A indices greater than or equal to 16 are reported below.

DATE	GEOMAGNETIC DISTURBANCES (for the Australian region)
05 Aug 23	G3 (Planetary) G1 (Australia)

	GEOMAGNETIC WARNINGS AND ALERTS			
DATE	Nº.	BEGIN	END	ISSUED
03 Aug 23	43	05 Aug 23	06 Aug 23	Warning
03 Aug 23	44	05 Aug 23	06 Aug 23	Warning
05 Aug 23				Alert
07 Aug 23	45	08 Aug 23	09 Aug 23	Warning
18 Aug 23	46	18 Aug 23	18 Aug 23	Warning
31 Aug 23	47	02 Sep 23	03 Sep 23	Warning

Solar And Geophysical Indices

DATE	10cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX	DATE	10 cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX
01 Aug	175	5	108	16 Aug	160	5	119
02 Aug	173	9	131	17 Aug	152	4	136
03 Aug	163	3	106	18 Aug	150	8	128
04 Aug	171	8	107	19 Aug	151	5	112
05 Aug	176	18	133	20 Aug	146	4	120
06 Aug	174	1	105	21 Aug	149	7	118
07 Aug	170	8	110	22 Aug	151	4	122
08 Aug	159	3	113	23 Aug	147	1	115
09 Aug	153	5	106	24 Aug	144	5	110
10 Aug	156	5	105	25 Aug	139	1	118
11 Aug	153	2	112	26 Aug	139	4	115
12 Aug	148	4	107	27 Aug	142	5	115
13 Aug	150	2	120	28 Aug	142	4	114
14 Aug	154	2	109	29 Aug	142	3	104
15 Aug	158	2	120	30 Aug	139	3	100
				31 Aug	140	5	111

DATE	10cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX	SUNSPOT NUMBER		FLARES
	Monthly Average	Monthly Average	Monthly Average	Monthly Average	13-month smoothed	>M1.0
Sep 22	135.1	7.9	74.6	96.3	96.2	13
Oct 22	133.5	7.9	82.1	95.4	99.1	19
Nov 22	123.4	7.3	76.1	77.6	101	6
Dec 22	132.3	8.1	83.5	113.1	104.5	43
Jan 23	182.3	7.1	118.6	143.6	113.3	42
Feb 23	173.5	10.3	115	110.9	117.9	51
Mar 23	157.2	9.3	131.5	122.6	120.2	21
Apr 23	145.8	8.3	119.3	96.4	121.2	9
May 23	156	6.5	97.7	137.9	122.8	60
Jun 23	161.7	5.5	97.5	163.4	123.6	21
Jul 23	177.1	4.9	103.5	159.1	121.6	52
Aug 23	153.7	4.6	114.5	114.9	119.5	27
					Predicted sunspot numbers	

SPECIAL NOTE
In June 2015, WDC-SILSO, Royal Observatory of Belgium, Brussels, adjusted their original observed sunspot numbers (Version 1.0) to a Version 2.0 series in which the sunspot numbers are higher. In the Version 1.0 data series, some of the sunspot numbers were weighted. The new (Version 2.0) sunspot numbers are unweighted sunspot number counts (for more information see: www.sidc.be/silso/home). The Bureau of Meteorology SWS solar cycle prediction is now based on the Version 2.0 values. As a result of this recalibration, the observed monthly and observed and predicted smoothed sunspot numbers are higher in the monthly table and solar cycle graph.

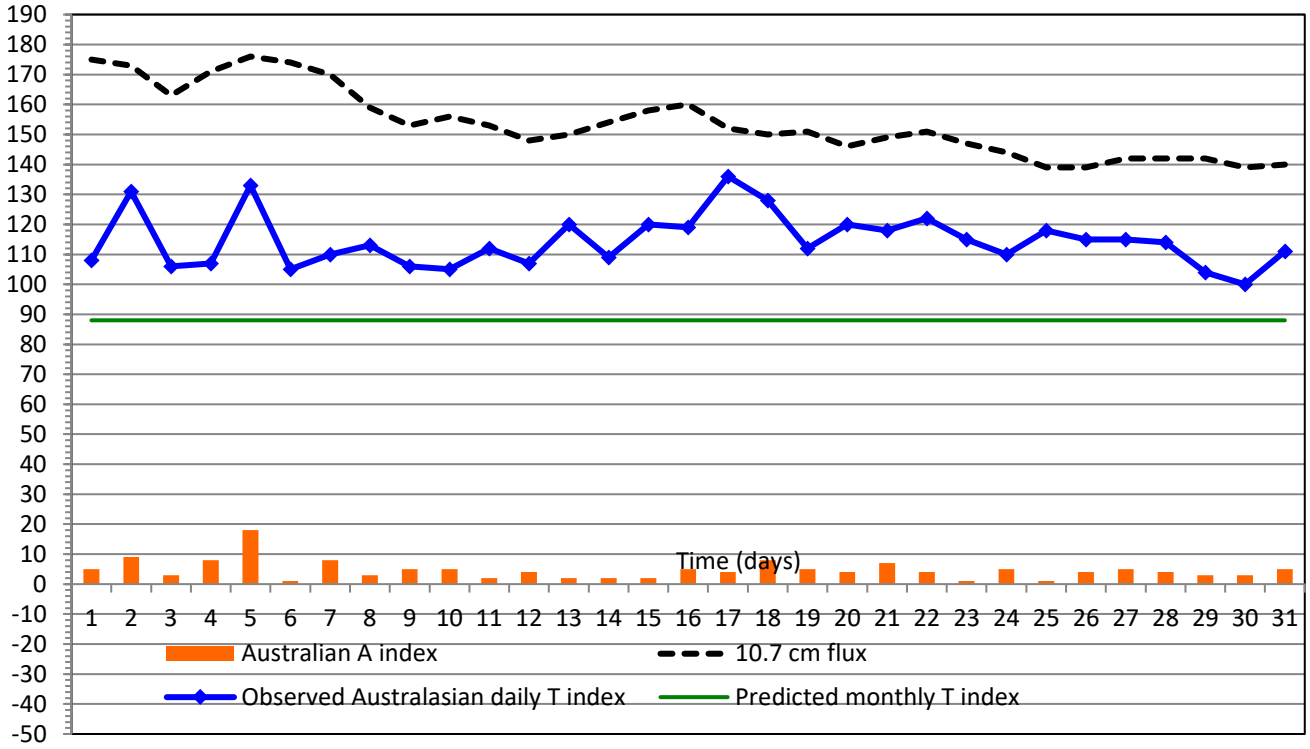
.

SWS WORLD T-INDICES

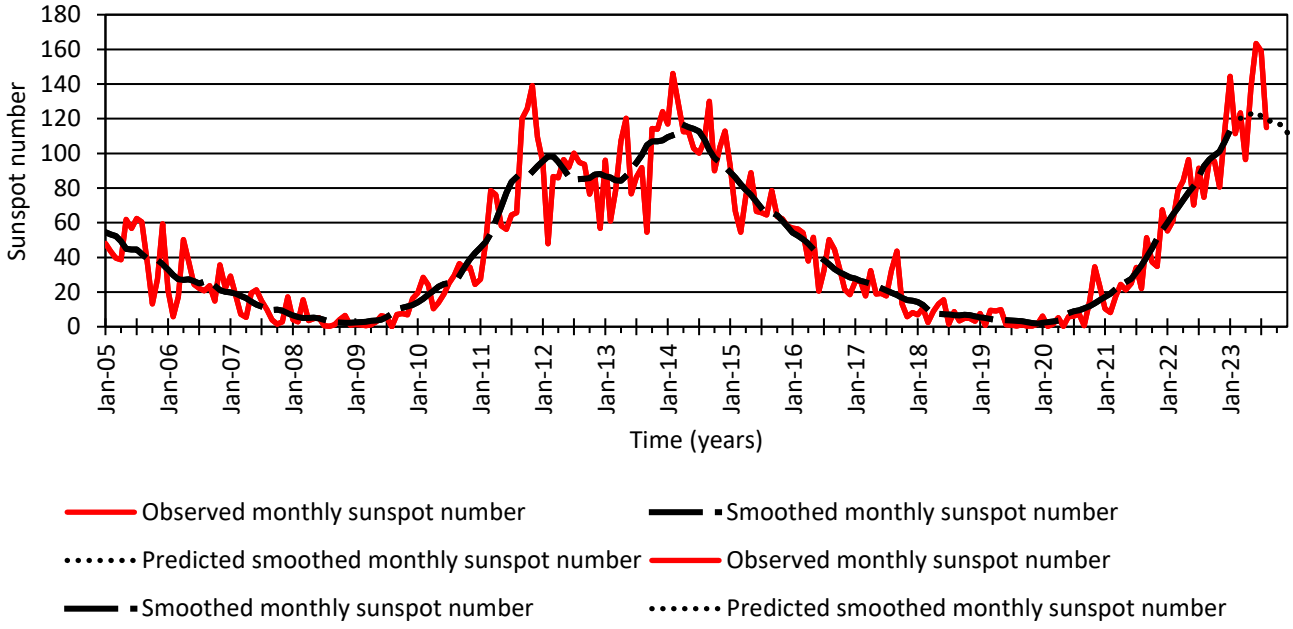
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	8	2	3	-2	-6	-3	-3	-8	-6	-10	-15	-9
2019	-5	-3	-4	-4	-9	-14	-11	-14	-11	-14	-16	-12
2020	-2	-5	2	-1	-7	-7	-9	-2	-6	-6	7	12
2021	12	4	10	6	6	12	21	12	23	23	17	28
2022	41	52	63	71	81	65	67	56	72	75	65	71
2023	107	114	119	105	101	110*	91	88	84	81	78	75

SWS predicted T-index * New observed data. T-index value may have changed

Solar and Geophysical Indices - Aug 2023



Solar Cycle



Observed monthly sunspot numbers courtesy of WDC-SILSO, Royal Observatory of Belgium, Brussels (www.sidc.be/silso/home)

NOTES - notes - NOTES - notes - NOTES - notes

a. Times quoted in this publication are all Universal Time (UT).

b. The values of all indices are provisional. Final values are not available for several months.

c. M or X class flares refer to the X-ray classification system for solar flares. In this system, X class flares are more energetic than M class flares.

FLARE CLASS	X-RAY FLUX DENSITY	
	Ergs/cm^2/sec	W/m^2
M	0.01-0.1	10^{-5} to 10^{-4}
X	>0.1	> 10^{-4}

d. Class M flares, particularly the less energetic ones, are likely to cause a fadeout on only the lowest frequencies. Class X flares are likely to cause a fadeout over the entire HF spectrum. It should be noted that a fadeout will only occur on those circuits having a reflection point in the daylight hemisphere of the earth. Circuits having only night hemisphere reflection points will not be affected no matter the energy of the solar flares.

e. The 10cm flux is the radio power of the sun at a frequency of 2800 MHz (wavelength 10.7 cm). This flux is a good indicator of solar activity and is widely used in place of the sunspot number. The values are measured by the Penticton radio observatory, Canada. Unlike the sunspot number, the 10cm flux never drops to zero even during solar minimum. With no sunspots visible on the solar disk, the 10cm flux will still have a value of around 67. The table below gives a (statistical) comparison between 10cm flux and sunspot number. The 10cm flux is measured in solar flux units (10^{-22} W m^{-2} Hz^{-1}).

SUNSPOT No.	10 cm FLUX
0	67
20	78
40	93
60	110
100	147
150	195
200	243

f. Ionospheric disturbances refer to measurements made across Australia, but are generally applicable to mid-latitude Southern Hemisphere conditions. Spread F conditions indicate tilts in the ionosphere, which may result in multipath fading on some HF circuits.

g. The magnetic A-indices are for the Australian region. Large values for the A index correspond to disturbed conditions. Levels of magnetic disturbances are described in the following terms.

A INDEX VALUE	DESCRIPTION
0 up to 7	Quiet
8 up to 15	Unsettled
16 up to 24	Active
25 up to 35	Minor Storm
36 and above	Major Storm

h. The Australian daily T-index is a measure of the average of the ionospheric critical frequencies available on a particular day - the higher the value of the T-index, the higher the ionospheric critical frequencies (and Maximum Usable Frequencies on HF circuits) for that day. The T-index is based on data from Australian ionospheric stations and so is most applicable to HF circuits with reflection points in the Australian region.

i. The SWS monthly observed T-index is derived from the observed monthly median values of foF2 for each hour from ionospheric stations worldwide.

The predicted smoothed monthly T-indices are computed by using a statistical analysis of the observed monthly T-indices for all solar cycles since 1938.

The SWS T-indices may not be updated each month but only when sufficient new data becomes available.

SPACE WEATHER SERVICES
PO BOX 1386, HAYMARKET NSW 1240
AUSTRALIA

GENERAL ENQUIRIES: +61 2 9213 8000

DUTY FORECASTER: +61 2 9213 8010

FACSIMILE: +61 2 9213 8060

E-mail**:** asfc@bom.gov.au

Web**:** www.sws.bom.gov.au

`