



**Australian Government**  
**Bureau of Meteorology**

IPS RADIO AND SPACE SERVICES

**S**OLAR

**A**ND

**G**EOPHYSICAL

**S**UMMARY

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February 2010

# Solar Activity

Solar activity ranged from Very Low to High levels with eight M-class x-ray flares observed. The largest flare this month was an M8.3 on 12 February produced by active region 11046. Nine spot groups given Boulder region numbers ranging from 11043 to 11051 were visible on the solar disc this month. The other M-class x-ray flares were produced by Boulder AR11045. This is an increase in activity from last month, making a dramatic increase in activity for the year of 2010 so far. M-class x-ray flares for the month are listed below.

DATE	FLARE ALERT	SWF ALERT *
06 Feb 10	Flare Alert	
07 Feb 10	Flare Alert	
08 Feb 10	Flare Alert	
12 Feb 10	Flare Alert	
13 Feb 10	Flare Alert	
07 Feb 10		SWF Alert (0228-0254 UT)

## PROTON ALERT

DATE	BEGIN TIME	END TIME
None Issued.		

## FLARES

DATE	CLASS >M1.0	CLASS X	EVENT MAX	DURATION >M3
06 Feb 10	M2.9/SN		1859UT	
06 Feb 10	M1.3		2137UT	
07 Feb 10	M6.4/1N		0234UT	0220-0239UT
08 Feb 10	M4.0		0743UT	0736-0746UT
08 Feb 10	M1.1		1203UT	
08 Feb 10	M2.0		1347UT	
12 Feb 10	M8.3/1N		1126UT	1119-1128UT
12 Feb 10	M1.1/2F		1808UT	

Total Number of M-flares 8, X-flares 0  
 Total Number of flares for Feb is 8

# Ionospheric Conditions

No significant ionospheric depressions were observed this month. On the other hand, beginning on 8 February the Ionospheric conditions in the Australian/NZ region were elevated compared with predicted monthly values due to strong EUV from the sunspot regions on the solar disc.

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<b>DATE</b>	<b>IONOSPHERIC DISTURBANCES (MUFs for the Australian Region)</b>
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None issued

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### **RADIO COMMUNICATIONS WARNINGS**

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<b>DATE</b>	<b>N°.</b>	<b>BEGIN</b>	<b>END</b>
06 Feb 10	01	07 Feb 10	07 Feb 10
07 Feb 10	02	07 Feb 10	08 Feb 10
09 Feb 10	03	09 Feb 10	11 Feb 10
12 Feb 10	04	13 Feb 10	15 Feb 10

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# Geomagnetic Activity

No significant geomagnetic disturbances were observed this month. However, on 15 February there was a prolong period of a southerly Bz component in the interplanetary magnetic field reaching a peak of -13nT, that resulted in isolated periods of Active and Minor storm activity levels in the Australian and Antarctic regions. The Australian A index for this day was 14. Only disturbances with Australian A indices greater than or equal to 16 are reported below.

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<b>DATE</b>	<b>GEOMAGNETIC DISTURBANCES (for the Australian region)</b>
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<b>GEOMAGNETIC WARNINGS AND ALERTS</b>				
<b>DATE</b>	<b>N°.</b>	<b>BEGIN</b>	<b>END</b>	<b>ISSUED</b>

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09 Feb 10	01	09 Feb 10	11 Feb 10	Warning
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# Solar And Geophysical Indices

DATE	10 cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX	DATE	10 cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX
1-Feb	75	9	7	15-Feb	88	11	27
2-Feb	75	8	9	16-Feb	87	8	20
3-Feb	74	9	12	17-Feb	87	4	29
4-Feb	74	4	2	18-Feb	85	6	44
5-Feb	78	4	3	19-Feb	84	5	39
6-Feb	88	6	10	20-Feb	84	4	36
7-Feb	90	6	16	21-Feb	84	4	46
8-Feb	94	5	26	22-Feb	84	5	52
9-Feb	91	3	24	23-Feb	84	3	44
10-Feb	91	6	28	24-Feb	83	4	48
11-Feb	94	8	32	25-Feb	83	3	34
12-Feb	96	5	35	26-Feb	81	2	37
13-Feb	94	4	24	27-Feb	79	2	32
14-Feb	89	5	43	28-Feb	78	6	34

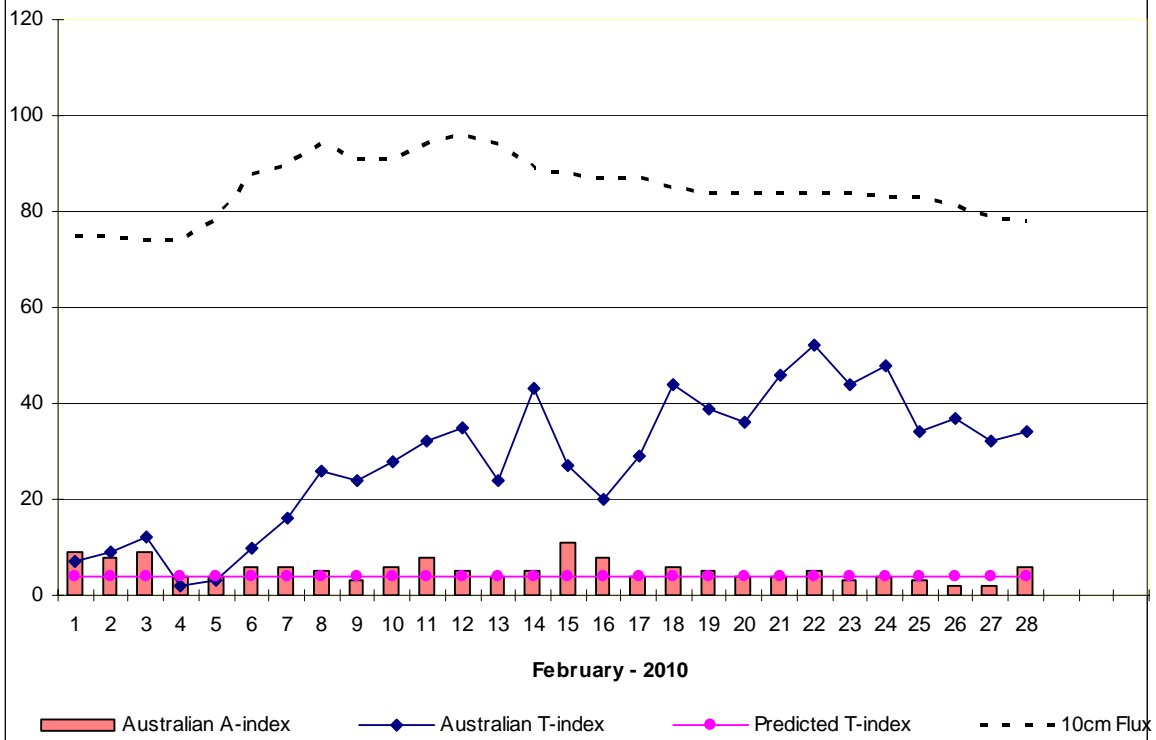
MONTH/ YEAR	10cm FLUX	AUSTRALIAN A-INDEX	AUSTRALIAN T-INDEX	SUNSPOT NUMBER		FLARES
	Monthly Average	Monthly Average	Monthly Average	Monthly Average	Yearly Average	>M1.0
Mar-09	69.4	5.3	-4.1	0.7	2	0
Apr-09	69.7	4.5	3.4	1.2	2.2	0
May-09	70.6	3.3	6.1	2.9	2.3	0
Jun-09	68.6	3.4	2.9	2.6	2.7	0
Jul-09	68.3	3.5	-0.7	3.5	3.6	0
Aug-09	67.4	4.5	0.8	0	4.8	0
Sep-09	70.5	4.3	-3	4.2	5.9	0
Oct-09	72.4	4.8	-2.8	4.6	6.5	0
Nov-09	73.6	4.7	-10.9	4.2	6.6	0
Dec-09	76.8	3.5	-16.5	10.6	6.7	0
Jan-10	81.1	4.1	4	13.1	6.9	5
Feb-10	84.8	5.3	28.3	18.6	7.3	8

Predicted Sunspot numbers

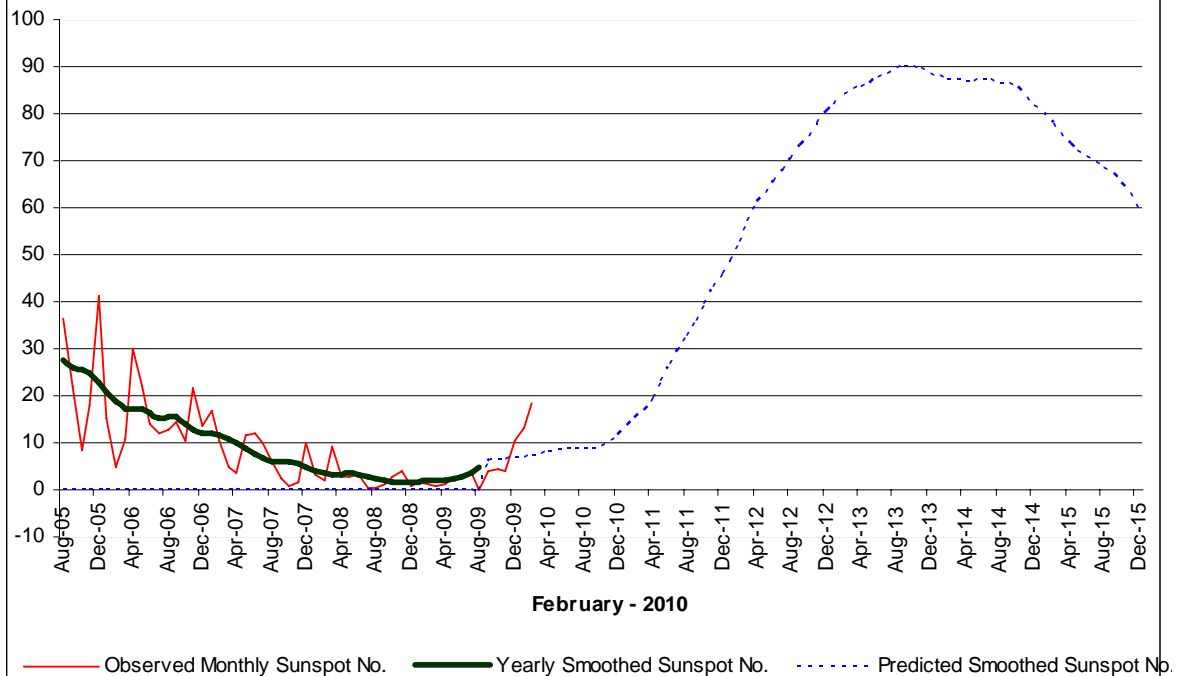
IPS T-INDICES												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	40	41	38	32	31	29	34	29	26	22	17	26
2006	27	24	11	20	24	14	20	8	17	8	8	12
2007	16	13	9	8	9	11	7	5	6	5	-2	5
2008	9	6	4	1	-5	-11	-7	-7	1	-3*	-4*	-10*
2009	-1	-3	-3	1	4	0	0	-1	5	4	-2	2*
2010	13*	29*	7	8	8	9	9	8	8	9	10	11
2011	11	13	15	18	21	24	27	30	34	38	41	44
2012	46	51	55	59	61	63	66	68	71	73	76	78
2013	80	82	83	83	84	85	86	87	88	88	87	86
2014	86	85	85	84	84	85	85	84	84	83	81	79
2015	77	76	74	71	70	68	67	66	65	63	61	57
2016	54	50	48	46	45	43	41	40	38	36	35	35
2017	34	33	32	30	28	27	25	24	22	21	19	18
2018	17	16	15	14	13	13	12	11	11	11	10	10
2019	9	9	8	8	7	7	7	7	7	7	7	7

IPS Predicted T index      \* = new data. T index may have been changed

## Solar and Geophysical Indices

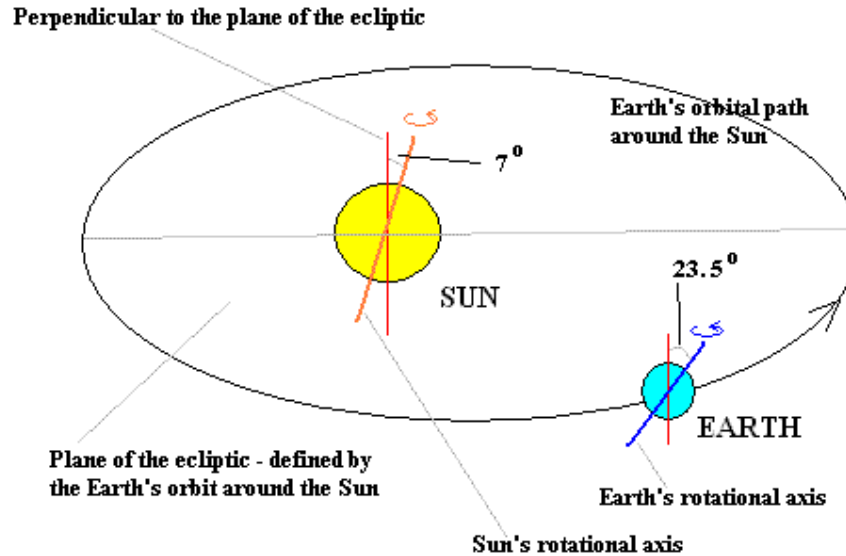


## Sunspot Number - Solar Cycle 24



## THE ORIENTATION OF THE SUN AND EARTH IN SPACE

The revolution of the Earth in an elliptical (but nearly circular) orbit around the Sun defines a plane that is called the 'plane of the ecliptic'. This is used as a reference plane to describe the orientations and motions of all other bodies in the solar system.



The above diagram, which is not to scale, shows the Earth and the Sun. It is general knowledge that the Earth's rotational axis is inclined at almost 23.5 degrees with respect to the perpendicular of the ecliptic plane. This is course what produces the seasons on the Earth. Not so widely known is that the Sun's rotational axis is also inclined, but with a smaller angle of 7 degrees. Over a short time interval these axes appear to be fixed with respect to the distant stars, pointing to a fixed place on the (imaginary) celestial sphere. However, over time scales of many thousands of years they do precess and nutate (wobble).

These orientations complicate solar observations. The Sun's tilt causes its poles to nod with respect to a terrestrial observer. Sometimes the north pole is just visible, and sometimes the south pole is visible. This changing angle in a plane toward and away from the observer is termed the B angle, and as expected, it varies from +7 to -7 degrees throughout an Earth year. In the plane of the sky (the plane perpendicular to the observer's line of sight), the solar axis appears to rotate back and forth throughout the year. The range of this angle, designated the P angle, is from -26 to +26 degrees. We might initially expect a P angle variation of  $\pm 30.5$  degrees ( $23.5 + 7$ ). However, the relative orientations of the Sun and the Earth at this time do not allow us to perceive this maximum variation, although over many centuries this will change.

# 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 <sup>2</sup> /sec	W/m <sup>2</sup>
M	0.01-0.1	10 <sup>-5</sup> to 10 <sup>-4</sup>
X	>0.1	> 10 <sup>-4</sup>

- 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<sup>-22</sup> W m<sup>-2</sup> Hz<sup>-1</sup>).

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 T-index is a measure of the average level 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 IPS Monthly T-index for ASAPS is derived from the observed monthly median values of foF2 for each hour at up to 40 ionospheric stations worldwide. These records become available from IPS stations in Australia very soon after each month, but the majority are received up to one year later. This means that the exact observed value of the monthly T-index is not available until some months later.

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 IPS T-indices for ASAPS may not be updated each month but only when sufficient new data becomes available.

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