

**Space Weather Technical Forecast**

Issued on Tuesday, 06 June 2023 at 13:29 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>**

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**Space Weather Forecast Headline: Chance of M-class flares (R1/Minor-R2/Moderate radio blackouts). Slight chance of a G1/Minor Geomagnetic Storm 07/08 June.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Low, but with background X-ray flux at low C-class levels. There are currently ten sunspot regions on the visible disc. AR3323 nearing centre disc in the southern hemisphere remains the largest and most complex region, although has recently shown some signs of slow weakening. AR3327 in the southeast has seen development of trailing spots and may contain a marginal, small, delta configuration. The other regions appear to be mostly small and/or simple, with little change since last assessed. A new region appears to be rotating over the southeast limb at present at around S23 latitude, although is too foreshortened in available imagery to make a confident assessment at this time.

No Earth-directed CMEs were observed in available imagery during the period.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters as observed by DSCOVR at L1 have shown some slight disturbance, thought to derive from one or more weak transients. Wind speeds were initially slightly elevated, around 410 km/s, decreasing to ~350km/s around 06/0000 UTC before increasing to become slightly elevated again with speeds of 420km/s at the end of the period. Density has been largely at average levels. Total IMF, Bt, was at moderate levels at first, with a peak of 11nT at 05/2218 UTC, but has since erratically declined to become weak since. The north-south component, Bz, was largely positive, with a few generally short-lived periods of negative Bz, varying between +9/-8nT. Phi angle has been almost entirely positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV), as observed by GOES16, has remained at background levels. High energy electron flux (greater than 2MeV), as observed by GOES16 has been at largely background levels. Associated 24-hour fluence has been below the Active threshold (1e8 integrated pfu) on a generally steady trend. Electron fluence observed at 06/0000UTC was 1.36e6 integrated pfu.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar activity is expected to remain generally Low but there is a chance of isolated M-Class flares bringing Moderate activity, and a slight chance of isolated X-Class flares. These most likely to occur from the two largest regions located in the southern hemisphere.

**Solar Wind / Geomagnetic Activity:** A filament lift-off starting around 04/0900UTC from the southwest quadrant resulted in an observed CME. A glancing blow at Earth is possible, although not guaranteed, either late Day 2 or more likely into Day 3 (07-08 June). Generally solar winds expected to remain at slightly elevated or slow-ambient levels. Perhaps seeing a slight enhancement Day 2-3 should Earth experience any CME effects.

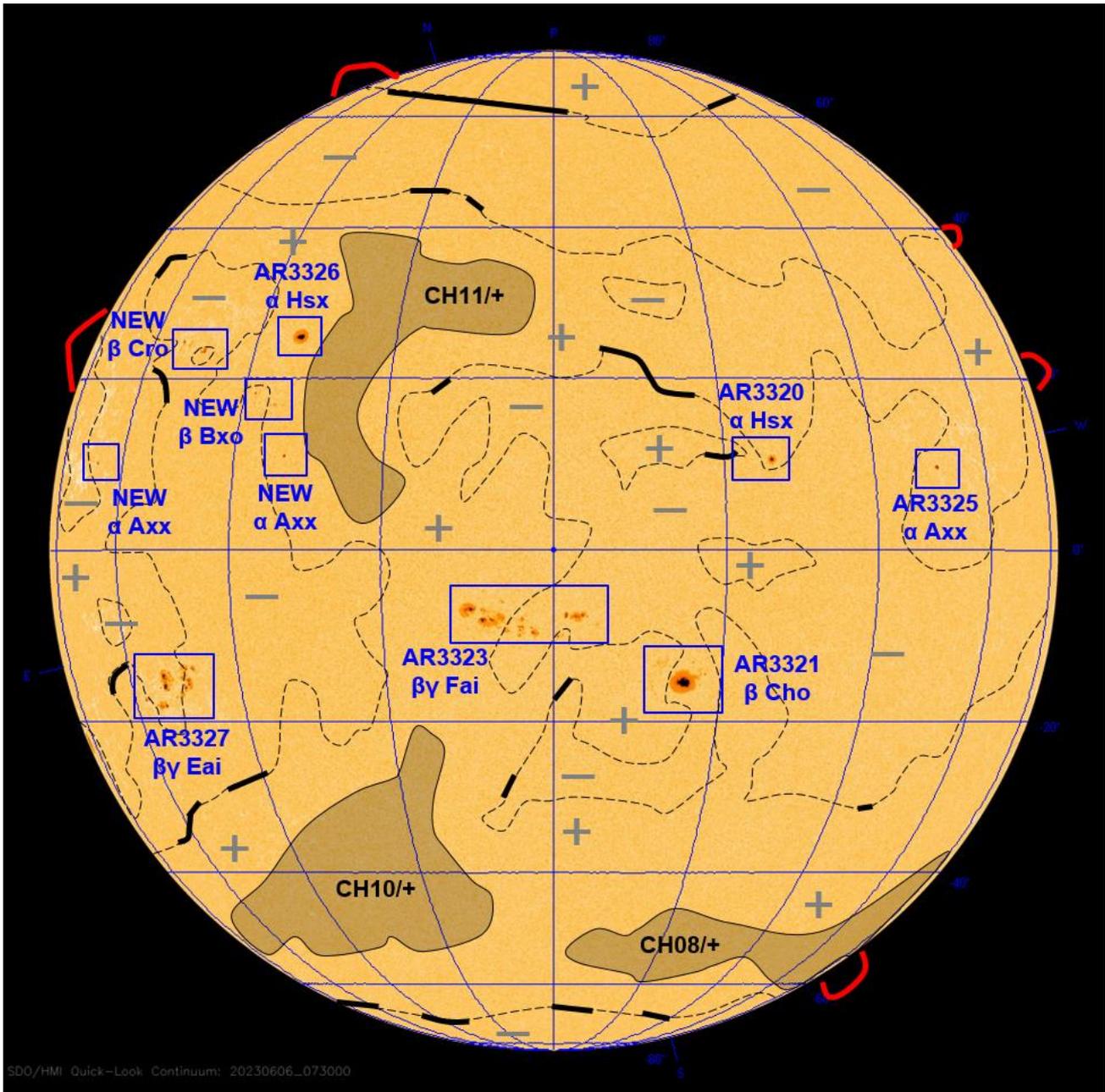
Geomagnetic activity is forecast to be mainly Quiet to Unsettled with a slight chance of Active intervals on Day 1 (06 June), should we continue to see any weak CME enhancements. Activity possibly increasing late Day 2 into Day 3 (07-08 June) should we see any CME effects, becoming more Unsettled with a chance of Active intervals and a slight chance of isolated

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G1/Minor Geomagnetic Storm intervals.

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain at background levels, however there is a very slight chance of reaching the S1/Minor Storm threshold should any larger flares occur. High energy electron flux (greater than 2MeV) is expected to be at mostly background or moderate levels. Electron fluence is also expected to continue below the Active ( $1 \text{e}8$  integrated pfu) threshold, but probably see a gradual increase.

Figure 1. Solar Analysis Valid 06/0730 UTC.



**Key:** Filament      , Prominence      , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson  $\alpha$ - $\beta$ - $\beta\gamma$ - $\beta\gamma\delta$  and Zurich-McIntosh Axx etc.

**Geomagnetic Storms:**

A filament lift-off starting around 04/0900UTC from the southwest quadrant resulted in an observed CME. A weak glancing blow is possible either late on Day 2 (07 June) or more likely early Day 3 (08 June), although some Enlil ensemble members have this feature as missing Earth entirely. No other Earth directed CMEs currently feature in the forecast.

CH08/+ in the southern hemisphere is considered to have largely transited beyond a geoeffective position on the visible disc with the next high-speed stream from CH11/+ in the northern hemisphere not forecast to become geo-effective until 10 June. Some potential transient CME activity has been observed in the past 24hrs, which is also expected to wane through the rest of Day 1 (06 June). Solar winds are expected to remain slightly elevated to slow ambient.

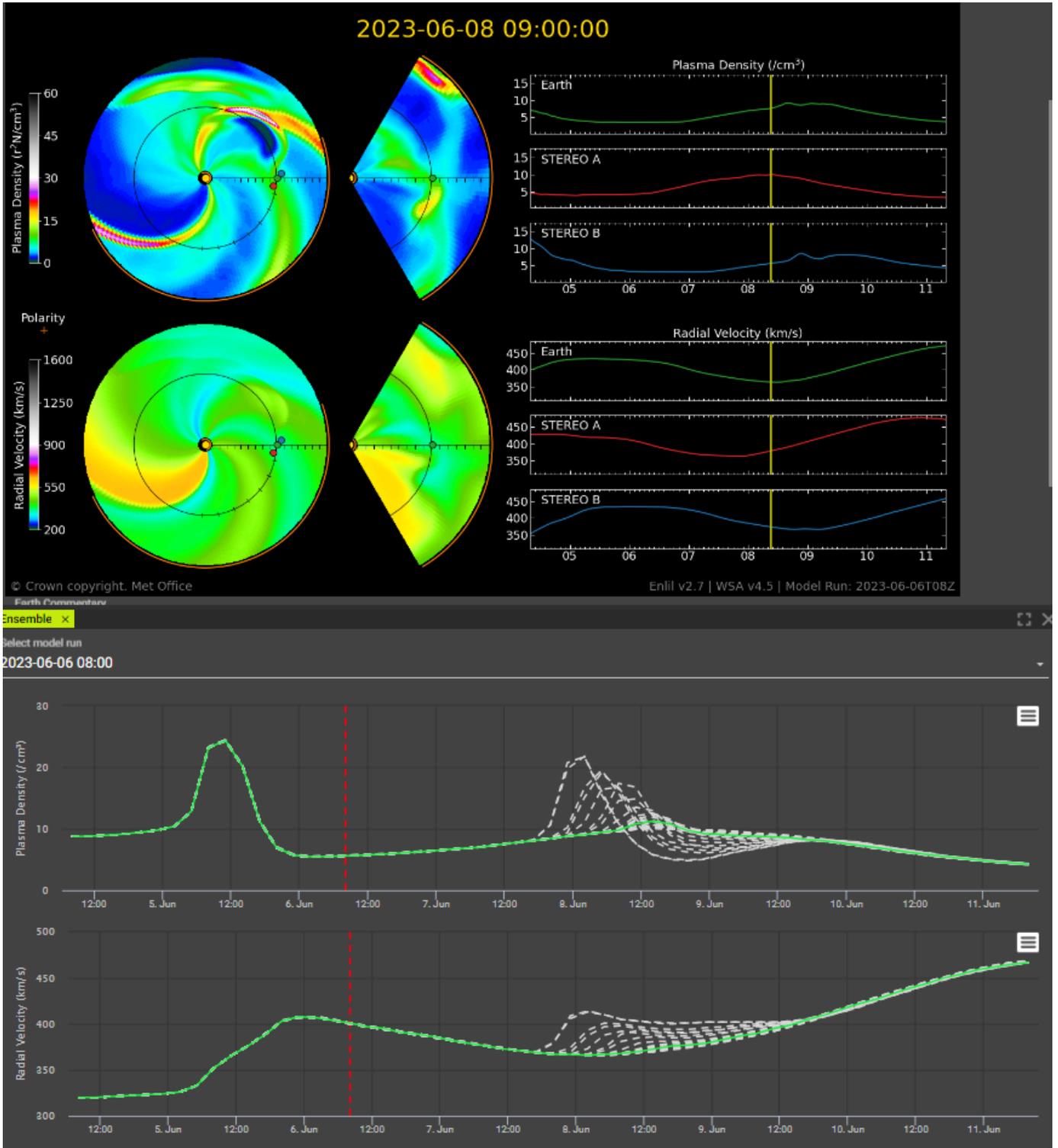
Geomagnetic activity is forecast to be mainly Quiet to Unsettled with a slight chance of Active intervals on Day 1 (06 June), should we continue to see any weak CME enhancement. Activity possibly increasing late Day 2 into Day 3 (07-08 June) should we see any CME effects, becoming more Unsettled with a chance of Active intervals and a slight chance of isolated G1/Minor Geomagnetic Storm intervals.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	15	20	10
Strong	G3	No	1	1	2	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

**Geomagnetic Activity - Earthbound Coronal Mass Ejections**

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/1629	Partial	Filament Eruption	SW	620km/s	08/0000 UTC	Glancing blow possible. Moderate confidence.

Figure 2: MOSWOC Enlil and Ensemble forecast, indicating potential arrival of glancing CME arrival



**Radio Blackouts - X-Ray Flares:**

There are currently ten sunspot regions on the visible disc. AR3323 (Fai/Beta-Gamma) near southern centre disc remains the largest region, with a number of small intermediate spots, although in general the region appears to be simplifying. AR3327 (Eai/Beta-Gamma) in the southeast has seen development of its trailing spots and may still contain a marginal, small, delta configuration. The other regions appear to be mostly small and/or simple, with little change since the last assessment. A new region appears to be rotating over the southeast limb at present at around S23 latitude, although is too foreshortened in available imagery to make a confident assessment at this time. A number of new and returning regions are expected to rotate across the eastern limb Days 1 (06 June), supported by STEREO EUVI imagery.

Overall, solar activity is expected to remain generally Low but there remains a chance of isolated M-flares producing Moderate activity, and a very slight chance of isolated X-flares. These most likely from AR3323 or AR3327.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

**Solar Radiation Storms - (High Energy Protons):**

The high energy (greater than 10MeV) proton flux is at background levels, where it is expected to remain. There is a very slight chance of S1/Minor Radiation Storms should any larger flares occur from AR3323 near the southern central disc.

Radiation Storms	Level (cm <sup>-2</sup> sr <sup>-1</sup> s <sup>-1</sup> )	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	5	5
Very Active	≥ S3 *	No	1	1	1	1

\* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm<sup>-2</sup>sr<sup>-1</sup>s<sup>-1</sup>)

**High Energy Electrons Event (≥ 2MeV):**

High energy electron flux (greater than 2MeV) is expected to remain at mainly background to Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: [moswoc@metoffice.gov.uk](mailto:moswoc@metoffice.gov.uk)

moderate levels through the period. The possibility of a CME glancing blow late Day 2 into Day 3 (07-08 June) would also keep electron levels suppressed, although could cause charging at the end of the forecast period. Confidence in the CME arrival is low, with a chance the CME could miss Earth entirely.

Electron fluence is well below the Active ( $1e8$  integrated pfu) threshold. It is expected to stay below Active through this period, although a rise is possible Days 3-4 (08-09 June), but this is low confidence. MOSWOC REFM is forecasting an increasing trend, but remaining well below Active levels. This is considered to be reasonable guidance at this stage.

GEO Electron Environment	Level ( $\text{cm}^{-2} \text{sr}^{-1}$ $\text{day}^{-1}$ )	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	5	8
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: Latest GOES16 Electron Flux and MOSWOC REFM forecast

