

Space Weather Technical Forecast

Issued on Thursday, 29 June 2023 at 01:26 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>

Space Weather Forecast Headline: Active electron fleunce. Moderate solar activity likely. Slight chance of G1/Minor Storm day 3 (1st July).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with an M1.9 flare observed at 28/0844UTC from the vicinity of AR3340 in the northwestern quadrant. AR3340 (Eai/Beta) has a history of moderate solar activity, but appears to be fading. However, this may be due to foreshortening effects as it approaches the northwest limb. AR3354 (Ekc/Beta-Gamma-Delta), near centre disc has continued its growth and development over the past 24 hours. It is now a large and complex region, with at least one delta spot. There are five other regions presently on the disc, with AR3348 fading to plage during the period. All these regions remained small or simple, with no significant change.

A CME which left the northeast of the Sun late on 27 June from the vicinity of AR3354 has been analysed and is forecast to glance the Earth on 01 July, but with low confidence. No further Earth directed CMEs were observed in the period.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, was slightly elevated but gradually declining from around 470 to 430 km/s. Density has been below average (<5 ppcc). The total magnetic field strength was weak, around 5 nT, with the north-south component, Bz, varying weakly. Phi angle was predominantly negative (towards the Sun), but with some weak deflections to positive early in the period. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at background levels. High energy electron flux (greater than 2MeV), increased from Moderate to High levels from 28/1040 UTC, with a diurnal maximum peak value of 3510pfu at 28/1555 UTC. The associated 24-hour fluence rose during the day, exceeding the Active threshold at 28/1800 UTC, with a peak of 1.15e8 integrated pfu at 29/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a slight chance of X-class flares, mainly from AR3354.

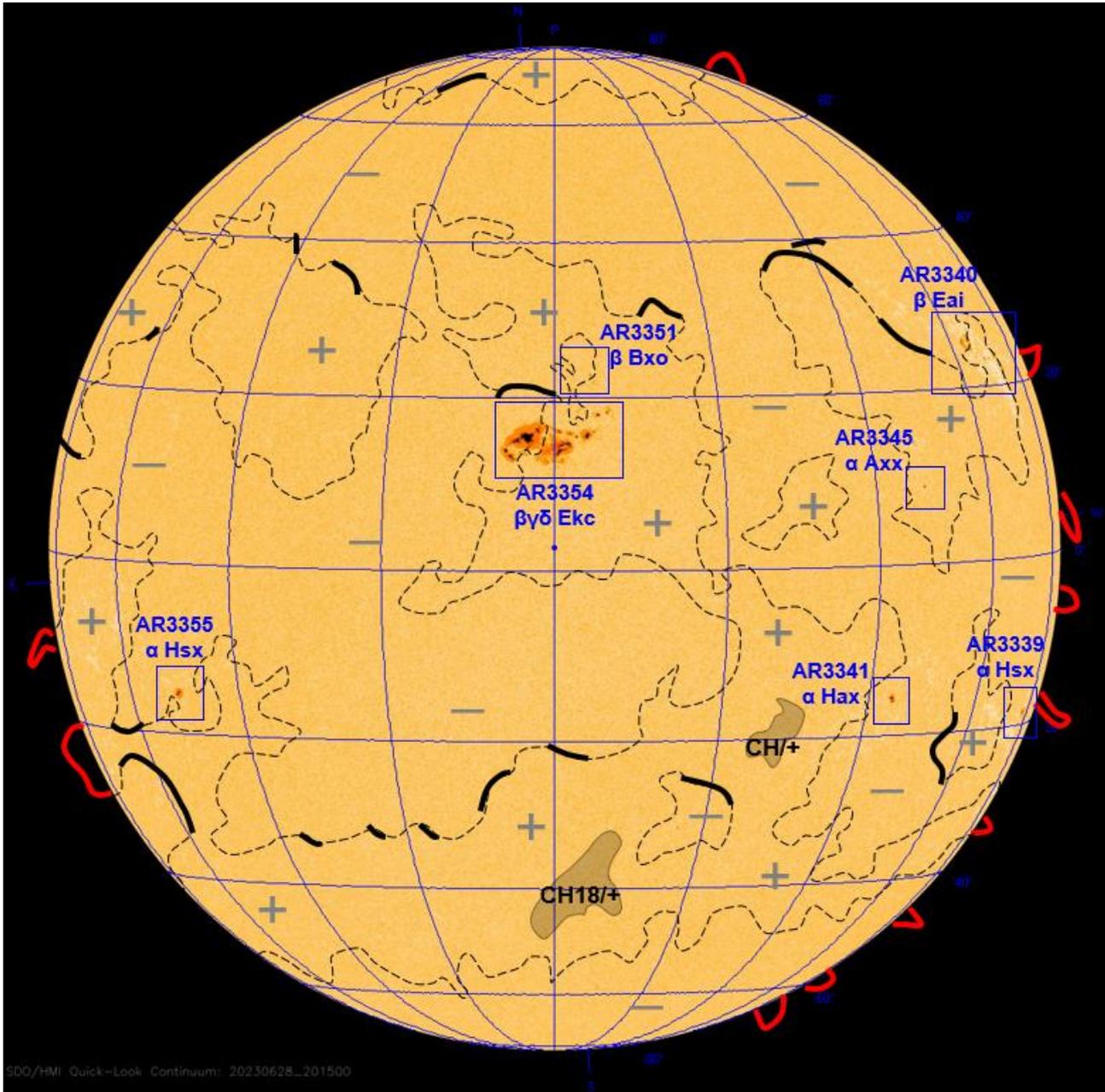
Solar Wind / Geomagnetic Activity: A CME which left the Sun on 27 June may glance the Earth on 01 July, but with low confidence. Otherwise, solar wind speeds are expected to be relatively muted. Geomagnetic activity is forecast to be Quiet to Unsettled, with a slight chance of a G1/Minor Storm around the 1st July due to the possible glancing CME.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is most likely to remain at background levels but with a slight chance of reaching the S1/Minor Storm level, mainly due to AR3354. High energy electron flux (greater than 2MeV) is likely to

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continue to peak at high levels at the diurnal maxima in the coming days but with a gradual declining trend likely. Active ($1e8$ integrated pfu) electron fluence is expected to continue through day 1 (29th June) before beginning a steady decline in response to the weakening electron flux.

Figure 1. Solar Analysis Valid 28/2000 UTC.



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

Geomagnetic Storms:

A CME which left the northeast quadrant of the Sun on 27 June may glance the Earth on 01 July, but this is low confidence, with a range of arrivals between 30 June and 02 July possible. Otherwise, solar winds are likely to be at ambient to slightly elevated levels, with only limited influence from coronal hole 18. This appears to be a weakening feature with only a slight enhancement noted during the previous rotation. No further coronal holes are discernible on current satellite imagery.

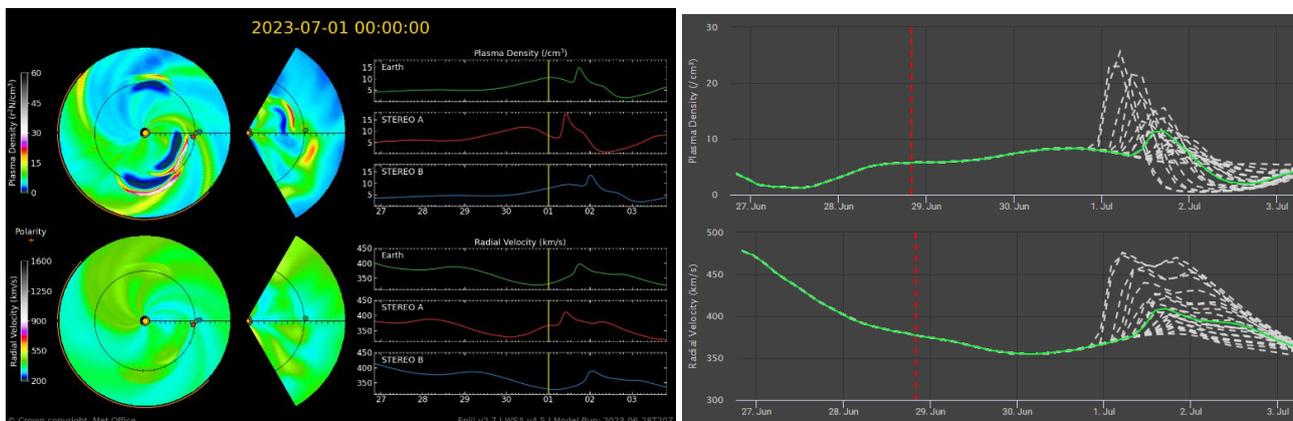
Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight chance of G1/Minor Storms later in the period due to the low confidence CME glance.

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)
			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	10	20	5
Strong	G3	No	1	1	1	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
28/0336	Partial	Filament Eruption	NE Quad, near AR3354	600 km/s	01/0600 UTC	Glancing impact possible but low confidence

Figure 2: MOSWOC Enlil, plus ensemble, showing possible CME glancing impact around the 1st July.



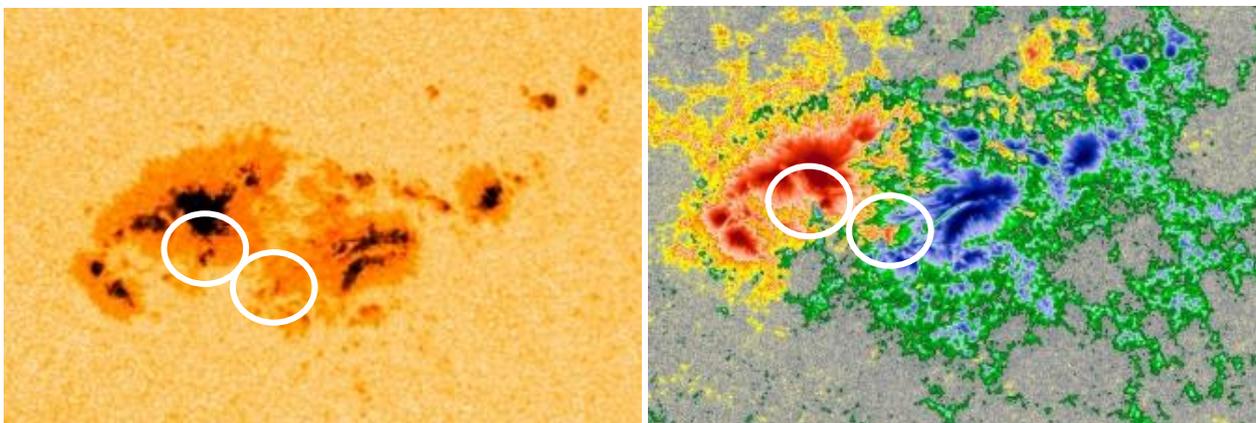
Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate, with one M-class flare observed from the vicinity of AR3340. This appears to be a fading region, but this appearance could be due to the location close to the northwestern limb. Otherwise, the disc is dominated by the rapidly evolving AR3354 (Ekc/Beta-Gamma-Delta), near centre disc. It continues to grow and now harbours one, possibly two delta spots. There are five other regions on the disc, but currently these have remained small or simple.

Low to Moderate solar activity is expected to continue through the forecast period, with a slight chance of X-class flares, most likely from AR3354.

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	Yes	60	60	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: AR3354 (Ekc/Beta-Gamma-Delta), with small delta spots indicated



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES16, is at background levels and is most likely to remain so throughout the period. However there is a slight chance of reaching the S1/Minor Storm threshold, mainly due to AR3354 and AR3340. AR3354 in particular has developed into a large and complex region, and is now beginning its transit across the western hemisphere.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻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	≥ S1	No	10	10	10	10
Very Active	≥ S3*	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has oscillated between moderate and high levels through the last 48 hours. This pattern is likely to continue over the next few days, but with gradual declining trend towards background levels. This decline may be sped up by the arrival of the CME on day 3 (1st July).

The electron fluence is currently at Active levels (>1e8 integrated). This is expected to continue through day 1 (29th June) before gradually declining below this level through days 2 and 3 in response to the weakening electron flux.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ 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	≥ 2 MeV ≥ 1x10 ⁸	Yes	100	80	40	30
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1

Figure 4: GOES 16 Electron flux and fluence, plus REFM data

