

Space Weather Technical Forecast

Issued on Thursday, 08 June 2023 at 01:17 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: Chance of M-class flares (R1/Minor-R2/Moderate radio blackouts). Slight chance of G1/Minor Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with an M4.7 flare observed at 07/1146 UTC. There has also been two larger C-class flares C7.1 at 07/0644 UTC and C9.0 at 07/1834. AR3327 (Eai/Beta-Gamma-Delta) was the source region for these. It is now the largest and most complex region on the disc, maintaining a small delta spot in its trailing region and development of its intermediary spots. AR3233 in the southwest disc continues its decline, with fading of the minor interior spots and main lead and trailer spots, to now be classified Cai/Beta. AR3329 (Dsi/Beta) in the northeast slowly continues to increase in size with well defined penumbra at both ends of the group and a few intermediary spots. The new region (AR3331) near the southeast limb is rotating into clearer view and appears to be Eso/Beta. There are 7 other regions on the disc, making a total of 11, but these remained small or simple.

A CME was observed leaving the sun around 07/0600 UTC closely followed by a long-duration C7.1 flare from near AR3327. Analysis suggests the CME is fairly narrow and behind earth-orbit. Another CME, associated with the A3327 M-flare was seen leaving the southwest quadrant, analysis is currently ongoing but this is also thought to be non-Earth directed.

Solar Wind / Geomagnetic Activity: Solar wind parameters as observed by ACE and DSCOVR at L1 have largely been at ambient levels, although a weak transient feature may have been detected towards the end of the period. Solar winds were generally slow between 320 and 400 km/s. Density has generally been below average (<5 ppcc), but increased to average (5-10 ppcc) at 07/2230 UTC. Total IMF, Bt, has been mostly weak, but increased to moderate levels from 07/2230 Utc, with a peak of 10 nT at 07/2333 UTC. The north-south component has continued to vary weakly. Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet (Kp 0-2).

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 with a peak of 1.56e6 integrated pfu at 07/0300UTC. Electron fluence observed at 07/0000UTC was 1.35e6 integrated pfu.

Four-Day Space Weather Forecast Summary

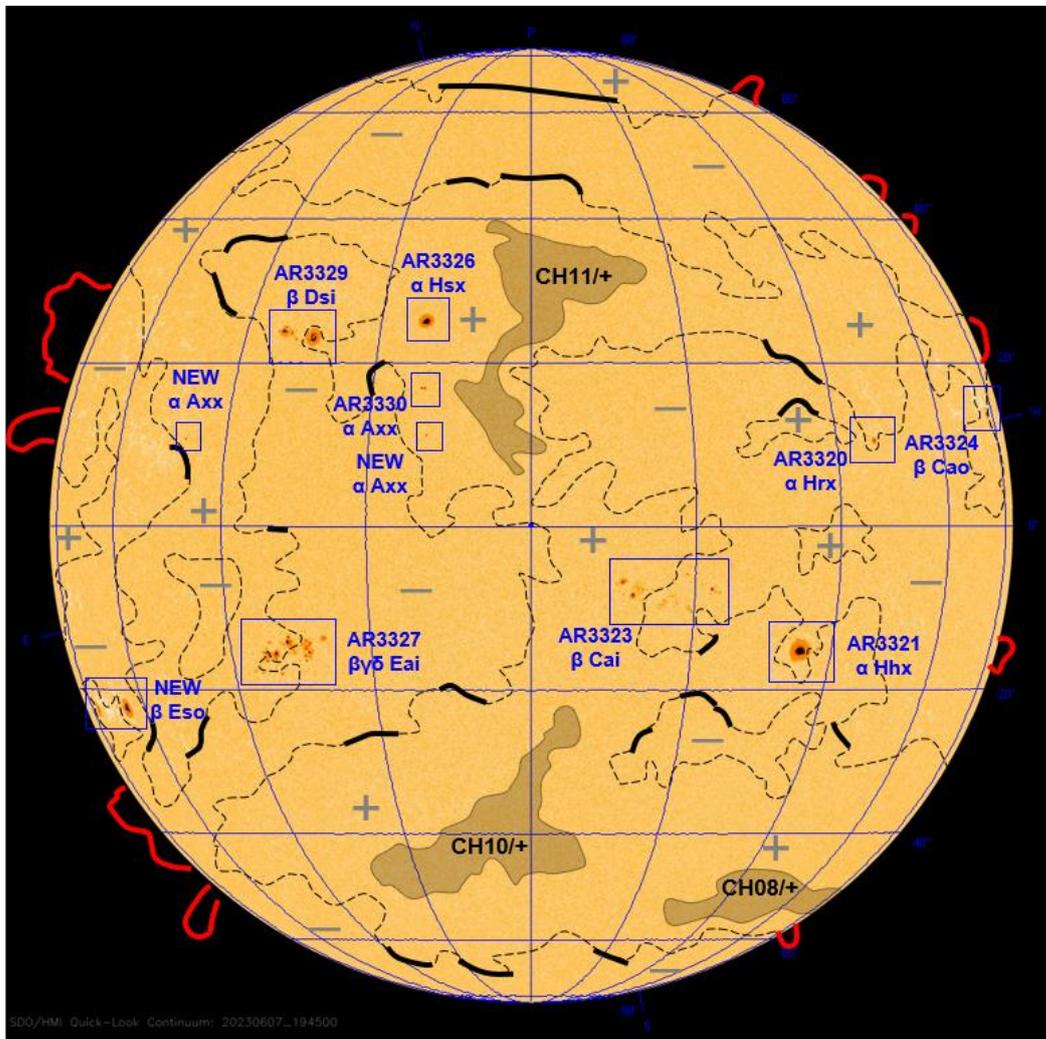
Solar Activity: Low to Moderate solar activity is expected, with a chance of further M-class flares and a very slight chance of isolated X-flares. Any significant flares are most likely to originate from AR3327 in the southeast of the disc.

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Solar Wind / Geomagnetic Activity: Glancing CME impacts are possible day 1 (8th) and less likely on days 3 and 4 (10th and 11th). Otherwise, ambient solar winds are expected to become slightly elevated or elevated on days 3 and 4 (10th and 11th) due to the arrival of positive coronal hole fast winds. Geomagnetic activity is forecast to be initially Quiet to Unsettled, with a chance of Active intervals and a slight chance of a G1/Minor Storm, should Earth see any CME enhancement on day 1 (08th). On days 3 and 4 (9th and 10th) activity is likely to become Quiet to Active, with a slight chance of G1/Minor Geomagnetic Storm intervals due to the arrival of coronal hole fast winds, perhaps coupled with CME influences.

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, but may experience charging later in the period due to coronal hole high speed stream effects. Electron fluence is also expected to continue below the Active (1e8 integrated pfu) threshold, but with an increasing trend towards the end of the period.

Figure 1. Solar Analysis Valid 07/2000 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 filament lift-off starting around 04/0900UTC from the southwest quadrant resulted in an observed CME. A weak glancing blow is possible on Day 1 (08 June), although a small number of Enlil ensemble members have this feature missing Earth entirely. Two other CMEs, which left the southeast of the Sun early on the 6th and 7th June respectively, are expected to miss behind Earth's orbit. However, there are a few ensemble members which would suggest the very slight possibility of a glancing blow feature, or for some transient effects to be observed on days 3 and 4 (09 and 10 June).

Current solar winds are at ambient background levels. In the absence of any aforementioned CME influences, the next HSS at Earth is anticipated on days 3 and 4 (09 and 10 June) from one or both of CH11/+ and CH10/+, with peak speeds of 450-500km/s likely.

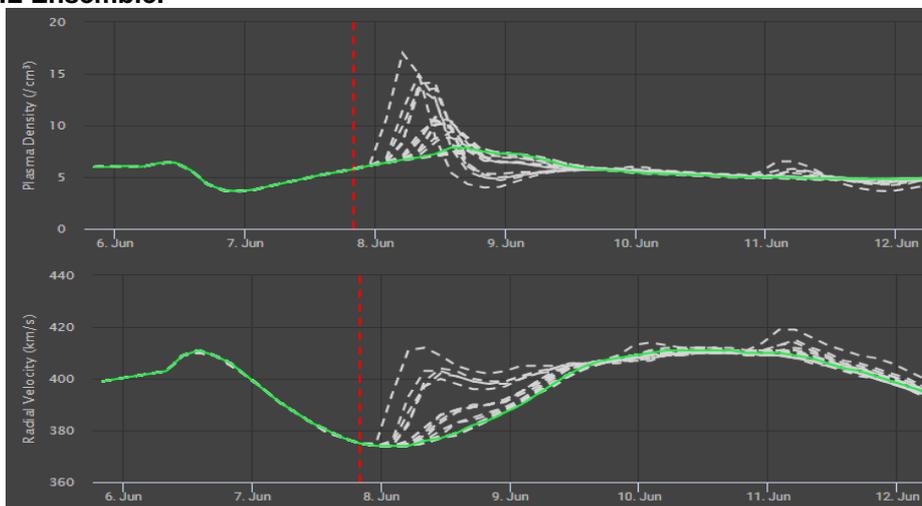
Geomagnetic activity is forecast to be initially Quiet to Unsettled, with a chance of Active intervals and a slight chance of a G1/Minor Storm, should Earth see any CME enhancement on day 1 (08 June). On days 3 and 4 (09 and 10 June) activity is likely to become Quiet to Active, with a slight chance of G1/Minor Geomagnetic Storm intervals due to the arrival of coronal hole fast winds, perhaps coupled with CME influences.

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	20	5	20	10
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
04/1629	Partial	Filament Eruption	SW	620 km/s	08/1000 UTC	Glancing blow possible.

Figure 2: ENLIL Ensemble.



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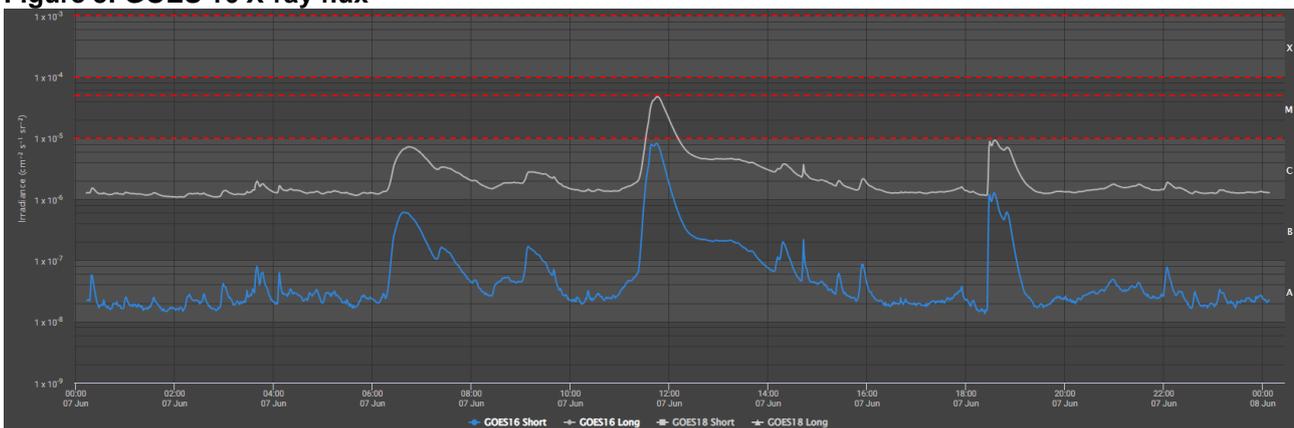
Radio Blackouts - X-Ray Flares:

There are currently eleven sunspot regions on the visible disc. AR3327 (Eai/Beta-Gamma-Delta) in the southeast quadrant is the most likely source of activity. It is a moderately large and complex region, with the proliferation of a large number of small spots of opposing polarity and the presence of a small delta spot in the trailing portion of the group. The region was responsible for an ongoing long-duration flare, with a peak flux of M4.7 at 07/1146 UTC. AR3323 (Eai/Beta) near the southern centre disc continues its slow decline, with fading of the minor interior spots and main lead and trailer spots. AR3329 (Dsi/Beta) in the northeast slowly continued to increase in size with well defined penumbra at both ends of the group and a few intermediary spots. A new region has emerged over the southeast limb, it currently appears to be a long Eso/Beta region, but will require further analysis as it comes further in to view.

Solar activity is generally expected to be Low to Moderate, with a chance of further M-flares and a very slight chance of isolated X-flares. The chance of flares reduces slightly from day 2 (9th), with AR3324 (Cao/Beta) transiting to the far side and no new regions are anticipated to rotate round the east limb during the period, according to far-sided products.

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	50	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16 X-ray flux



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. The most likely region for this is from the moderately large and complex region AR3327, which will be moving across the central portion of the disc over the coming days.

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	5	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) is expected to remain at mainly background to moderate levels through the period. The possibility of a CME glancing blow may also keep electron levels suppressed, although confidence in any CME arrivals is low. A coronal hole fast wind enhancement is likely to produce charging towards the end of the forecast period, with a chance of reaching the High levels on day 4 (11th).

Corresponding 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 anticipated on day 4 (11th).

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	No	1	1	5	10
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1