

Space Weather Technical Forecast

Issued on Friday, 09 June 2023 at 13:26 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: Chance of M-class flares (Minor-Moderate radio blackouts). Slight chance of G1/Minor Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are nine sunspot regions on the visible disc with AR3327, in the southeast quadrant containing a weak delta spot, but only providing low energy C-class flares through the next 24 hours. The only other region of note is AR3323 in the southwest quadrant which has weakened markedly over the last 24 hours. The remaining regions are all relatively stable and inactive. Solar activity has been Low. No CMEs that are likely to be Earth directed have been observed on available coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar wind at L1, has been at ambient levels on a declining trend falling to 280km/s. Density has been generally below average. Total magnetic field strength has been weak, with the north-south component near neutral throughout. Phi angle was resolutely positive (away from the Sun). Geomagnetic activity was Quiet throughout.

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 mainly background levels. The associated 24-hour fluence has remained well below the Active threshold (1e8 integrated pfu) on a steadily rising trend, with 1.73e6 integrated pfu observed at 09/0001UTC.

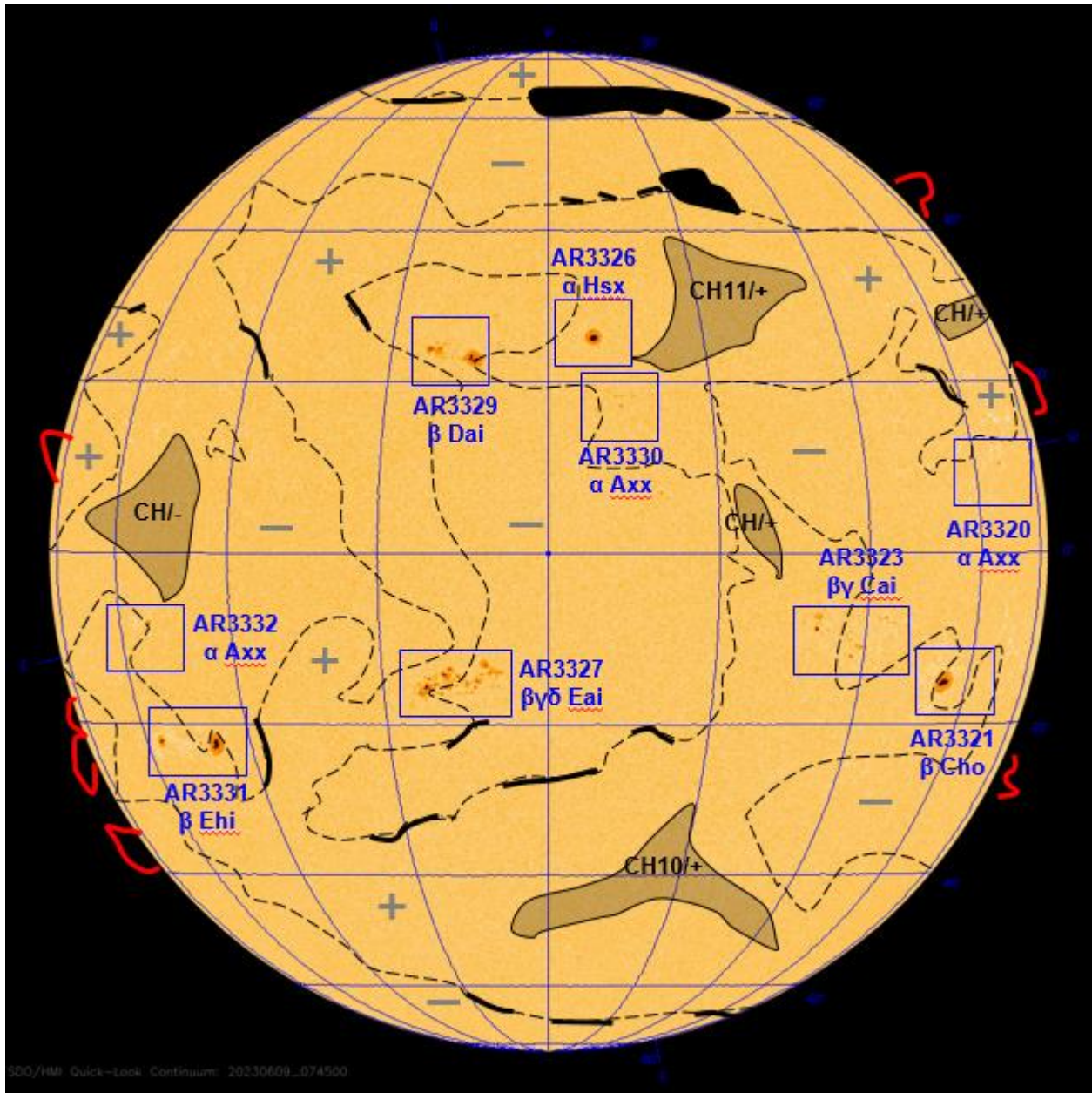
Four-Day Space Weather Forecast Summary

Solar Activity: Mainly Low to Moderate solar activity is forecast, with no significantly active regions on the solar disc. A potentially stronger region is due to rotate onto the disc during the next two days although this is low confidence.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected to affect the Earth, with a low risk of a glancing blow on 11 or 12 June. Coronal hole high speed streams from either coronal hole 10 or 11, may affect the Earth from 10 or 11 June, possibly giving speeds of 500km/s but with low confidence. Geomagnetic activity is forecast to be mainly Quiet, with a slight chance of Active or G1/Minor Storms on 10 or 11 June.

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 background to Moderate levels, but may increasingly exceed the high threshold on diurnal peaks later in the period. Electron fluence is expected to persist below the Active (1e8 integrated pfu) threshold, but with an eventually increasing trend.

Figure 1. Solar Analysis Valid 09/0800UTC.



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

Geomagnetic Storms:

No Earth-directed CMEs are expected in the forecast period, although Enlil is indicating a very slight risk a CME from an eruption in the southeast on 07 June, glancing the Earth on 11 or 12 June.

Coronal holes 10 and 11 are otherwise forecast to connect with earth either on 10 or 11 June as they move into geoeffective locations north and south of the solar equator, with a further coronal hole apparently developing between the two of these in west centre disc. Enlil is modelling the high speed streams from these features as missing the Earth, despite them appearing to be stronger and more distinct than previous rotations, when speeds of around 500k/s were observed. If the coronal holes connect then similar speeds are possible on this occasion, although this is an estimate as no high speed streams have been observed connecting with STEREO A.

Mainly Quiet conditions are forecast through the period, with a slight chance of Active or G1/Minor Storms due to the connection to the high speed streams, glancing CME or a low confidence combination of both.

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	20	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil forecast. The right hand image shows the side view, with the green dot representing Earth. The brighter colours to the north and south seem to indicate that the bulk of any high speed stream may miss Earth. The bright red colour to the south of Earth in the top right image represents the possible glancing CME.

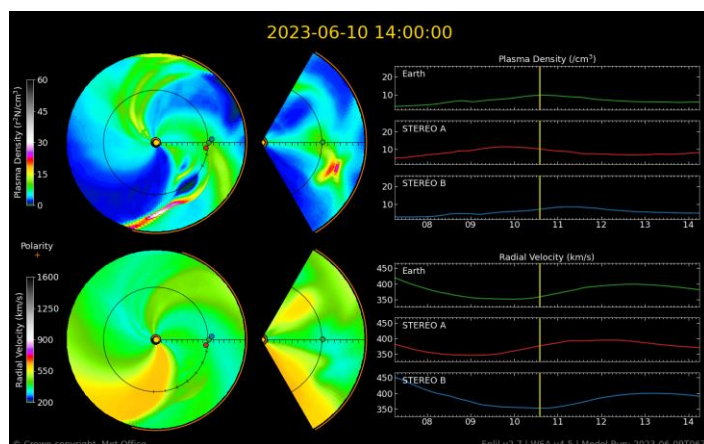
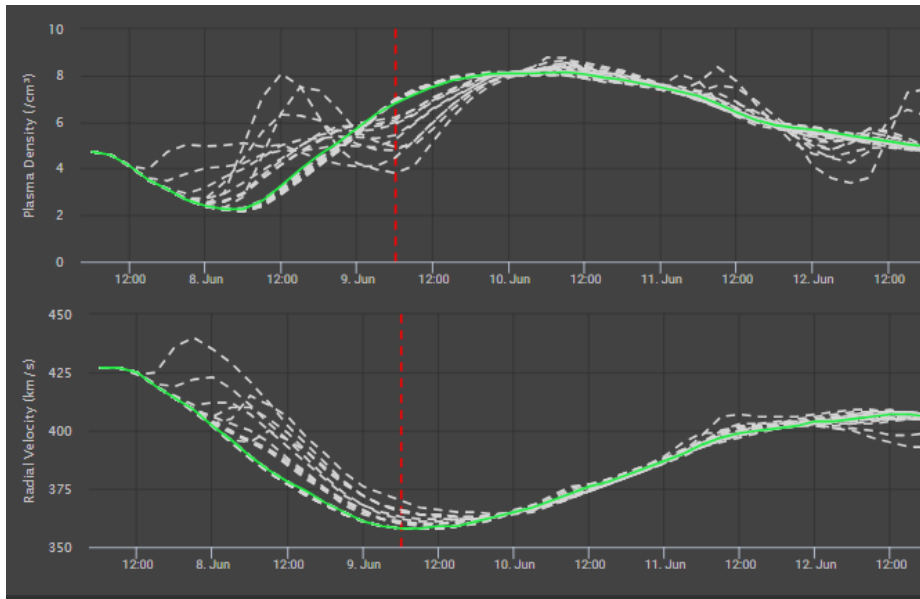


Figure 3: MOSWOC Enlil ensemble model with a limited number of ensemble members suggesting a CME glance on 11 or 12 June.



Radio Blackouts - X-Ray Flares:

There are nine sunspot groups on the visible disc, with only two significant regions. AR3327 is the most magnetically complex region, containing a weakening delta spot. This has also been the most active region, albeit only producing a number of low energy C-class flares. AR3323 in the southwest quadrant has weakened significantly, with only one prominent penumbra visible.

Overall solar activity has been below that of the raw risk predicted by the combination and arrangements of the different sunspot regions. Helioseismology is forecasting a strong region to rotate onto the southeast limb during 10 June, although this is low confidence. Mainly Low to Moderate solar activity is forecast, with a slight chance of Strong flaring.

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	30	30	30	30
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, with the most likely source being 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 flux (greater than 2MeV) is expected to be at mainly background levels through the period, with lower than normal confidence in any high speed stream connection from coronal holes 10 or 11 June. Presuming that the high speed streams connect with Earth, flux levels are likely to increase to moderate to high (1e3 pfu) levels, with the high threshold being increasingly exceeded on diurnal peaks.

Electron fluence is not expected to exceed the Active (1e8 integrated pfu) threshold with any high speed stream expected to be relatively muted. The MOSWOC REFM model is no providing good guidance in this respect, with the British Antarctic Survey Radiation Belt Model (BAS-RBM) suggesting that the greatest populations of electrons will be below GEO.

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	10	20
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1