MAG4

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Description

MAG4 forecasts the probability of SPE occurrence within the next 24 hours by calculating a free energy proxy for active regions on the Sun.

Inputs

LOS or Vector Magnetogram: From SDO/HMI at a 12 minute cadence.

Outputs

Probability of SPE occurrence: Probability that >10 MeV protons will exceed 10 pfu at Earth.

Model Version	Magnetogram Type	Flare History	Forecast Curve
MAG4_LOS_r	LOS	Yes	MDI
MAG4_LOS_FEr	LOS	No	MDI
MAG4_SHARP	Vector	Yes	MDI
MAG4_SHARP_FE	Vector	No	MDI
MAG4_SHARP_HMI	Vector	Yes	HMI

Forecast Lag Time

Inputs: About 1 hour from HMI cadence and downlink.

Run Time: Few minutes.

Validation

	H	FAR	TSS	HSS
MAG4_LOS_r				
MAG4_LOS_FEr				
MAG4_SHARP				
MAG4_SHARP_FE				
MAG4_SHARP_HMI	0.11	0.38	0.12	0.07

Interpretation and Caveats

Probability Reliability: Forecasted probabilities typically only range from roughly 1-40%. A probability near 40% should be interpreted as a strong chance of SPE occurrence.

Longitudinal Reliability: MAG4 is only reliable within 45 degrees of disk-center due to foreshortening. Predictions are still made outside of 45 degrees (up to 85 degrees), but the accuracy drops significantly.

Poor HMI Data: Very rarely, HMI data may be poor. This may lead to unreliable AR boxes, and therefore an unreliable forecast from MAG4.

Active Region Boxes: The vector magnetgram versions use HMI SHARPS for locating active regions. The LOS magnetogram versions use MAG4's custom algorithm.

Box Overlap: If two regions are very close, the boxes used to classify the region and calculate the free energy may surround both regions instead of keeping them separate. It is currently uncertain how this changes the forecasted probability.

Old Magnetograms: Very rarely, old magnetograms may be used as input leading to MAG4 producing incorrect predictions.

All-clear: A probability of 0-1% is considered all-clear while 2-100% is considered not clear.

Additional Links

iSWA Data Tree

CCMC MAG4 Description

SHARPs Description