Tackling Unproductivity Due to Solar Flares: Space Weather Forecasting for Industry

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technologies and communications? The Met Office produces reliable forecast resources that can help your business prepare.

High energy particles from the sun, solar flares, can reach Earth in as little as 8

Have space weather events caused complications for your

minutes. These can cause regular malfunctions in several technologies, such as satellites (i.e. GNSS and GPS), cable systems and radio propagation (i.e. highfrequency radio). The Met Office Space Weather Operational Centre (MOSWOC) has been offering warnings as to when to expect such events since its opening in 2014.

The Met Office has developed a standard model to predict upcoming solar activity

Forecasting space weather

and arrival of flares. Based on previous observations, these forecasts can be edited and verified by specialist space weather forecasters before they are

fields by using a magnetogram.

distributed to end-users:

1. A MOSWOC forecaster first analyses the current solar conditions. The principal features on the solar surface being examined are the regions of the sun that are most likely to emit a solar flare, known as active regions. Active regions are often recognised by the presence of sunspots — cool, dark spots on the surface, which can be identified due to their extremely strong magnetic

solar synoptic map, which is regularly developed by the forecaster for potential, future reference. Their details are presented to end-users, along with the rest of the forecast. 3. The model's forecasting technique predicts that the probability of a solar flare

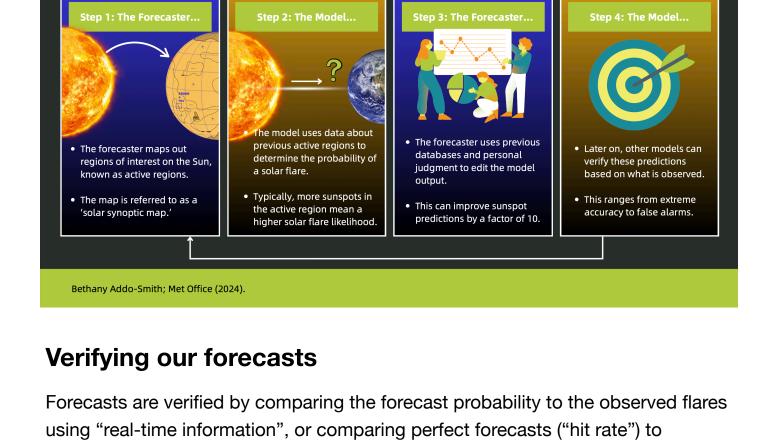
The location and size of active regions can be added to a map of the sun, a

depends on previous patterns and rates of flare emission. Therefore, the forecaster can use a database of previously recorded solar flares occurring to determine the "average daily flare rate." Using this value and the number of active regions recorded, the forecasting model can calculate the likelihood that a flare will be emitted. 4. The flare probability is used as the foundation for the flare forecasts, which the

forecaster can edit based on other data and their own expert judgement. The

process is repeated four times in a 24-hour period, producing an informed 4-

day forecast each time. The Forecaster-Model Relationship Met Office in Space Weather Forecasting



how forecast skill changes over time, typically decreasing day by day. These techniques are used to prevent unnecessary panic by setting probability

thresholds above which warnings must be provided to end-users. Human editing is essential to the accuracy of forecasts. Expert judgement generates Day 1 forecast reliability scores of 0.007 (0 being a perfect forecast), indicating that the observed frequencies and forecasted probabilities are very closely matched. End users should be aware that the Day 1 forecasts are typically the most reliable, followed by Days 2, 3 and 4.

In order to improve the MOSWOC forecasting system further, a new model,

mistaken forecasts ("false alarm rate"). Verification has been vital to determining

FLARECAST, is currently in development in partnership with the European Space Agency (ESA). The Met Office is frequently working in collaboration with astronautical and space observation experts, such as the Expert Service Centre at ESA, to improve the quality and range of products available to businesses. Resources and recommendations for businesses

Along with other products, MOSWOC offers two general space weather forecasts,

available in web or email format. All documents are updated and made available

For space agencies, aviation professionals, broadcasting medias, energy sectors and other industries in which space weather greatly and regularly affects

business proceedings, we recommend the <u>technical language forecasts</u>.

to the end user in 6-hour intervals across the day:

 For non-technological businesses that partially rely on satellite or telecommunications, such as public and private transportation sectors, we recommend the <u>plain language forecasts</u>.

The Met Office is already the preferred space weather forecast provider for several

Authority and National Grid, as recognised by the Department for Business Innovation and Skills, Cabinet Office: "The National Grid is reliant on the predictions of the Met Office. Protocols

have been developed and are in place between the Met Office and National

Grid to warn of a forthcoming event and maximise the time for mitigating

major public and private corporations in the UK, including the UK Civil Aviation

actions to be taken." Network Rail has also considered the use and applications of flare forecasts for public transport services:

Weather Operations Centre."

"...Network Rail has expressed interest in understanding how they would

respond to space-weather alerts, e.g. issued by the UK Met Office Space



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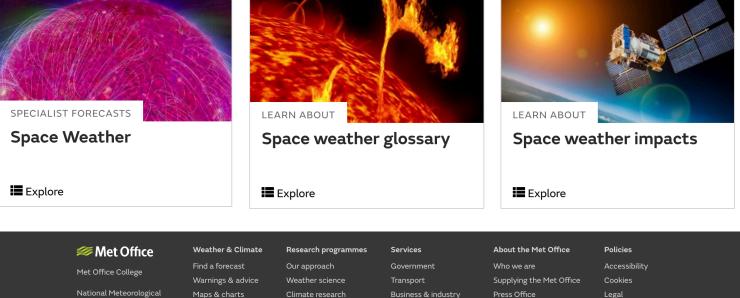
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