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Application of NWP verification methods to verify space weather forecasts

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The Met Office provides a range of operational Space Weather forecasts including arrival times of coronal mass ejections (CMEs), and probabilistic forecasts for relativistic electron fluences, proton and X-ray fluxes, and geomagnetic storm indices. These forecasts provide valuable information about the space weather phenomena which can have an impact on satellite electronics, radio communications and the electricity grid.

A key part of the monitoring and development of these operational services is the development of near-real time verification methods to evaluate the performance of these forecasts. An obvious first step is to adopt methodologies used to evaluate meteorological forecasts. To date, we have made progress analysing forecast and observed CMEs, including the use of 2 x 2 contingency tables which have been used to assess the forecast skill. From this, it has been possible to objectively compare the performance of Met Office forecasts to those produced by the NASA Community Coordinated Modelling Center, thereby providing an informative benchmark.

However, it is not possible to use the same approach for the other variables, for which the forecasts are probabilistic and categorical, e.g. the forecast gives the probability of exceeding low, medium and high particle fluxes. In addition, the probabilities are estimated subjectively by each forecaster based on the current conditions and their understanding of the key physical phenomena. Assessing the skill of these forecasts, therefore, requires a more sophisticated treatment than for the CME forecasts. Here, we discuss the application of appropriate verification techniques for these variables. Such techniques include the quantification of the forecast skill using the Rank Probability Skill Score (RPSS), comparing the forecasts against two benchmarks: climatology and persistence.