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## **Identifying the causes of the vertical component geomagnetic field anomaly at Eskdalemuir geomagnetic observatory, Scotland**

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### *Abstract*

Magnetic field observations in the Scottish Southern Uplands reveal a dampened amplitude in the vertical component variations at Eskdalemuir when compared with the horizontal components for periods less than an hour. This relationship is not observed elsewhere. A high conductivity feature beneath Eskdalemuir has been the focal point of past literature to account for this local anomaly. However, the impact of solar activities on the external field variations at Eskdalemuir has yet to be investigated as a possible cause. This is an important factor to consider because it is assumed that large current systems are uniform at mid-latitude for geomagnetic depth sounding techniques to be applied. When this assumption is violated, the vertical magnetic field is most sensitive to the presence of non-uniform contributions. In this study we aim to characterise the space-weather driven external field contributions at different timescales to the measured vertical field component, using long time series of modern data recorded at the Eskdalemuir magnetic observatory.

Vertical magnetic transfer functions (tippers) are estimated using three-month datasets at one-minute and one-second cadences between 2003 and 2019 in order to examine their temporal variations due to the impact from source effects. Our results show that at Eskdalemuir, there are significant variations in the tipper estimates for periods above 1000 seconds between summer and winter months for the same year, especially in the Real  $T_x$  component. These findings have implications for data collected during other field campaigns with shorter recording times.

241 words

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