Magnetic coverage. Distance away from each magnetic observatory is colour-coded from red to yellow. (left) locations of existing magnetic observatories (blue circles), (right) With the locations of the new magnetic variometers (green circles).

Closing the gap: reducing inter-observatory distance to <300 km across the UK and Ireland

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Overview

In 2022, BGS installed three semi-permanent variometers in Fermanagh (Northern Ireland), Market Harborough (Leicestershire) and Herstmoncuex (Sussex) [see table].

These sites were chosen to optimise the spatial distribution and ensure that no location in Britain is more than 300 km from a variometer (Figure 1).

Site	Latitude	Longitude
Florence Court (FLO)	54.25°	-7.72°
Market Harbourough (LEI)	52.43°	-0.92°
Herstmoncuex (HTX)	50.87°	0.34°

The variometer systems consist of a Sensys three-component fluxgate magnetomer, buried in a barrel for temperature stability, an EarthData Digitiser/Logger running Linux, a 4G modem, control electronics, two deep-cycle batteries for power and a solar panel to charge the batteries . The electronics and batteries are housed in a plastic shed to protect them from the weather (Figure 2). The magnetic sensor is orientated to magnetic north at each site (minimizing the east component).The magnetic field is measured once per second, recorded on the logger and sent back to the BGS across the 4G mobile phone network once every five minutes. Example data from a minor storms on 05-Jul-2022 are shown in Figure 3.

These installations will run until 2024 as part of the UK *SWIMMR* programme.

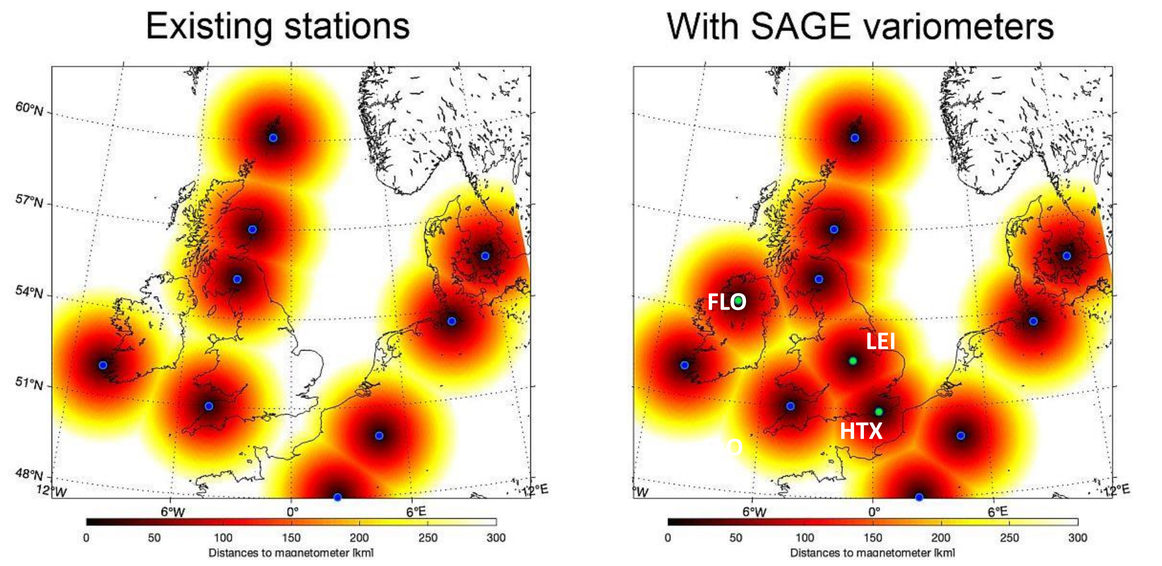

Figure 1. Improving magnetic data observation coverage: Heat map of distances to nearest magnetic observatory. (left) Locations of existing magnetic observatories (blue circles); (right) With the locations of the new magnetic variometers (green circles).

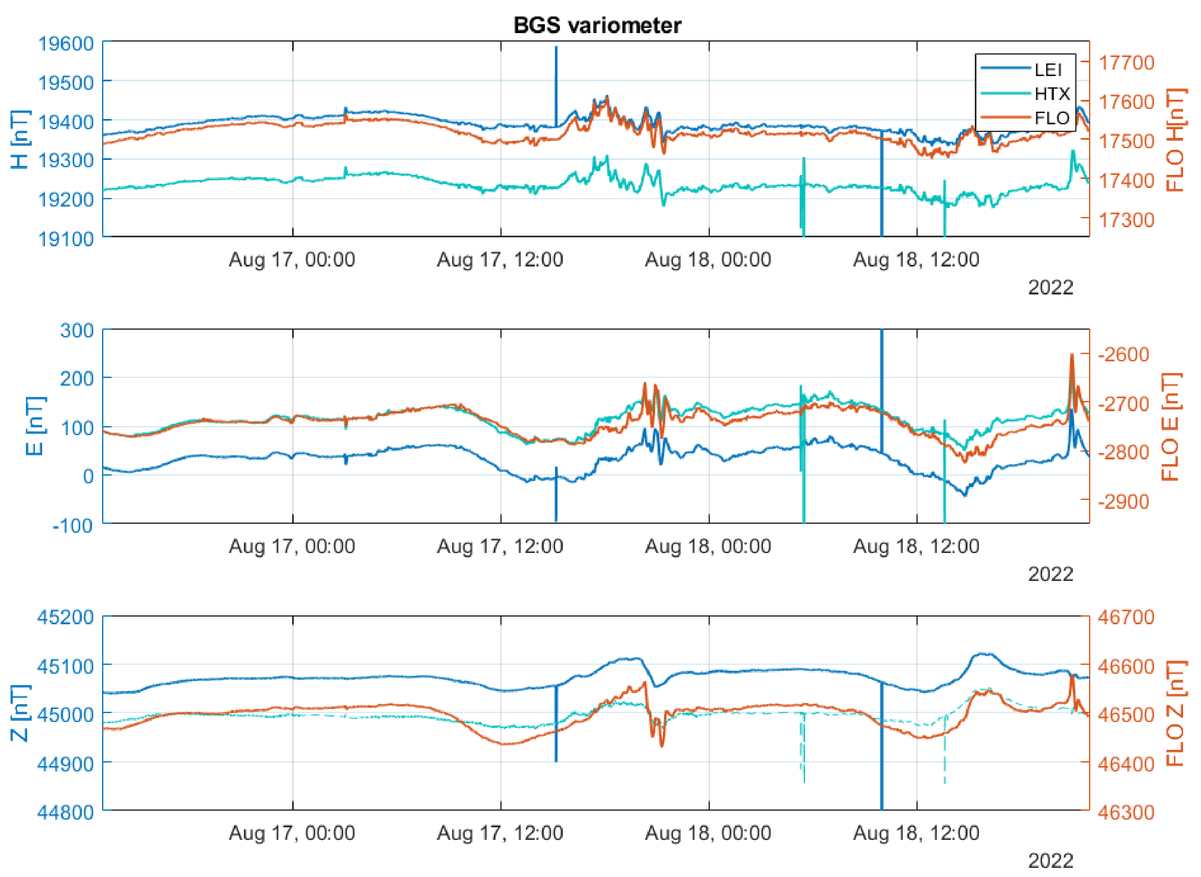

Figure 3. Example data for a minor geomagnetic storm on 18-Aug-2022 (Kp = 7-). FLO response is different in B_E (as expected, being further west). LEI has a damped Z component (which can be explained with higher electrical conductivity anomaly in the subsurface). HTX is slightly noisy due to proximity to nearby buildings (~100 m).

Data is available here:

https://geomag.bgs.ac.uk/research/SAGE/variometer_data.html

Florence Court Installation

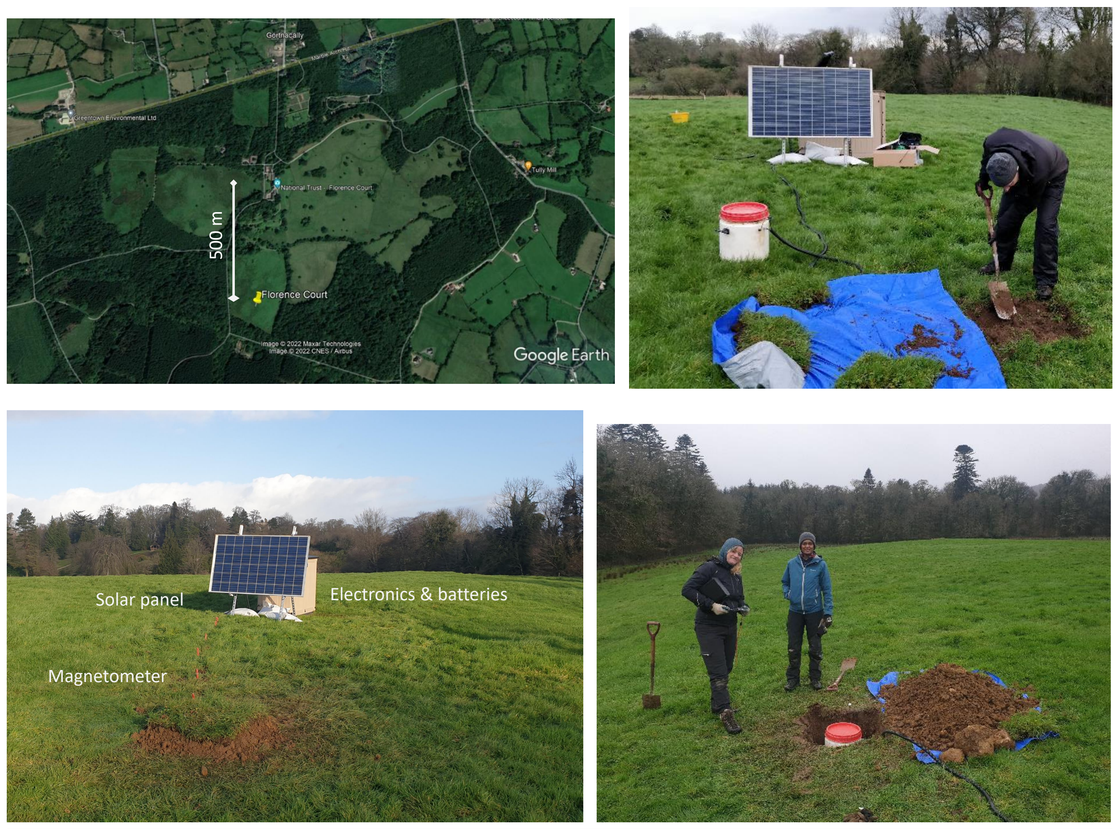

Figure 2. Top left: Location of variometer(yellow pin) in Florence Court estate near Enniskillen (Northern Ireland); top right: Digging the hole for the barrel containing the magnetometer located around 8 m from the electronics enclosure; lower right: magnetometer barrel before burial; lower left: completed installation.

Conclusions

- Very consistent magnetic response overall
- Stable real-time data feeds available
- High-quality data products suitable for space weather
- Coverage improved to <300 km between magnetometers

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