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Interactive comment on "Building a Raspberry Pi School Magnetometer Network in the UK" *by* Ciarán D. Beggan and Steve R. Marple

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Response: Manoj – we appreciate your time and efforts to read and comment on the manuscript. Please find our response to your queries and suggestions below.

Page 3: 1-5: Authors may also want to mention the geomagnetic substorm, which occurs almost on a daily basis at polar regions.

Response: We have added: 'On days without obvious magnetic activity, the solar wind loads the magnetosphere with energy over the course of several hours. This causes small 'substorms' to form in the polar regions through a process called the Dungey cycle (Dungey, 1961).'

Page 5 Lines 5-10: Where did you place the magnetometer during your initial mea-

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Discussion paper

surements? Do you have a recommendation for keeping the magnetometer in residential/school environments?

Response: During the initial measurements, the magnetometer was placed in an unused office on the fifth floor at the south end of the former BGS building (Murchison House) far away from the goods and passenger lifts. It was covered in insulation and placed in a box to reduce temperature changes. We did recommend putting the system at the back of a classroom, away from time-varying magnetic sources (doors, metal cupboards, radiators or beside electrical ducting). The best location was in Oundle who put theirs in an equipment lab in the centre of the building. The temperature is very stable and the system is undisturbed in general. However, we can only make recommendations not dictate where the system goes.

Page 5 Lines 25-30: You mention that the updated magnetometer also collects temperature data. Are you using the temperature data to calibrate the fluxgate outputs? It would be great if you can write a few lines about this. How do you deal with power outages? Can the system work off a battery?

Response: I have produced an updated version of Figure 3 for Reviewer 2 (C. Finlay) which shows how the temperature can be corrected for. I wouldn't say it is calibrated in the usual sense as the data are not absolute, but the temperature variation can be removed. We have added in: "However, though the systems are very temperature-dependent, it is possible to remove much of the error by 'backing-out' the measured temperature variation through calibration. We demonstrate this using a second-order polynomial model to compute the least-squares best-fit coefficients between the magnetometer differences in each component (H and Z) and temperature variation. These model fits are also shown in Figure 3 denoted 'corrected'. The linear coefficients are of the order of 3.8 nT/°C for the H component and 12.6 nT/°C for the Z component. Table 2 gives all six coefficients." The system is powered from the mains electricity. If the power goes out, then it stops working. We could add an in-line battery pack, but that requires more parts (charger, voltage regulator, battery) which would cost more money

– but it is eminently possible, of course.

Page 6 Lines 10:15. How did you orient the magnetometer properly in your school deployments? Did you face challenges with students/teachers misaligning the magnetometers?

Response: In half the schools, the system was personally installed and we instructed the teacher-in-charge how best to align the system by nulling the Y-component. However, the systems tend to get moved every few months in which case the alignment has changed. The only way to deal with this is post-process the data by rotating the horizontal magnetic values back to their approximate model values or nulling the Y component using quiet time values. This is not ideal, but makes the data usable for analysis.

Page 6 Lines 15:20. Can the students access the data locally?

Response: Yes, they can either get the data from the AuroraWatch website or use a USB memory stick to collect the data from the Raspberry Pi directly. I've added a sentence to clarify that.

Page 7 Lines 10:15. Regarding the quiet-day signal removal. Did you use a model to remove the Sq variations? How was the long-term performance of the magnetometer systems? Did you face issues with sensor/components going bad?

Response: For the analysis of the September storm, the quiet time value was assumed to be the average of the magnetic field components between 02:00 and 03:00 on the 7th September prior to the storm. We did not remove the Sq variations from the data, though they are relatively small compared to the storm signal (20 nT versus >200 nT). Thus far, there have been no electronic or electrical issues with the computer, digitiser or sensor themselves. They are surprisingly robust in that sense!

Page 8 Lessons Learned. You mentioned the challenges encountered during the long-term deployment in the school. A part of the issue is that the teachers have very little

time to devote to this experiment. This is a common problem faced by many citizen science projects. Is paying teachers/students is an option?

Response: It's an interesting proposal but I don't think we'd get money under an educational or outreach grant from the UK funding bodies. As I understand it, other organisations like UK Met Office have a huge number of unpaid volunteers who send in weather readings for free, for example. There's usually plenty of interested people – it is finding them and providing them with suitable equipment and training that is the main issue.

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