

829 hectares of preventive archaeological magnetometry surveys in Ireland: upscaling data collection and interpretation strategies

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Abstract

We present examples of preventive archaeology magnetometer surveys at macro scale. Qfield can be used for effective landscape documentation to allow better data analysis, even if done by another team. We show how to improve the reusability of datasets for future Big Data research methods.

Keywords

big data; magnetometer surveys; preventive archaeology; Qfield; re-usability of data

Introduction

During the autumns of 2021 and 2022 a total of 829 ha divided in 8 different preventive archaeology magnetometer survey projects were conducted by the Eastern Atlas team from Berlin in collaboration with the Irish geophysical company Minerex Geophysics. The surveyed areas consist of agricultural fields with an archaeological potential which have been designated as locations for yet to be developed solar farms. The main objectives of the survey were to determine possible archaeological features and deposits and to recommend targets for avoiding or direct archaeological testing. The spatial scale of the surveys required a new data collection and interpretation strategy to cope with the amount of fieldwork and data, which will be presented in this paper.

Equipment

Technical developments of geophysical survey technology lead to ultra-light, and high flexible multichannel magnetometer survey systems with RTK-GNSS positioning (Meyer et al. 2015). For large scale surveys we use the LEA system (Eastern Atlas), which is usually 5 m wide and equipped



Fig. 1: The LEA-MAX system in Ireland.

with 10 (LEA-MAX, Fig. 1) or 19 sensors (LEA-MAXIX) (Lambers et al. 2021). This technology available today enables us to cover large areas very efficiently and produce magnetic maps in 1-3 nT range. The system consists of a flexible array of 10 Fluxgate-Foerster gradiometer probes (FEREX 4.032 Con 650) towed by an ATV. The distance between each of the ten gradiometer probes is 50 cm, the row spacing of the measuring points between 5 and 10 cm,

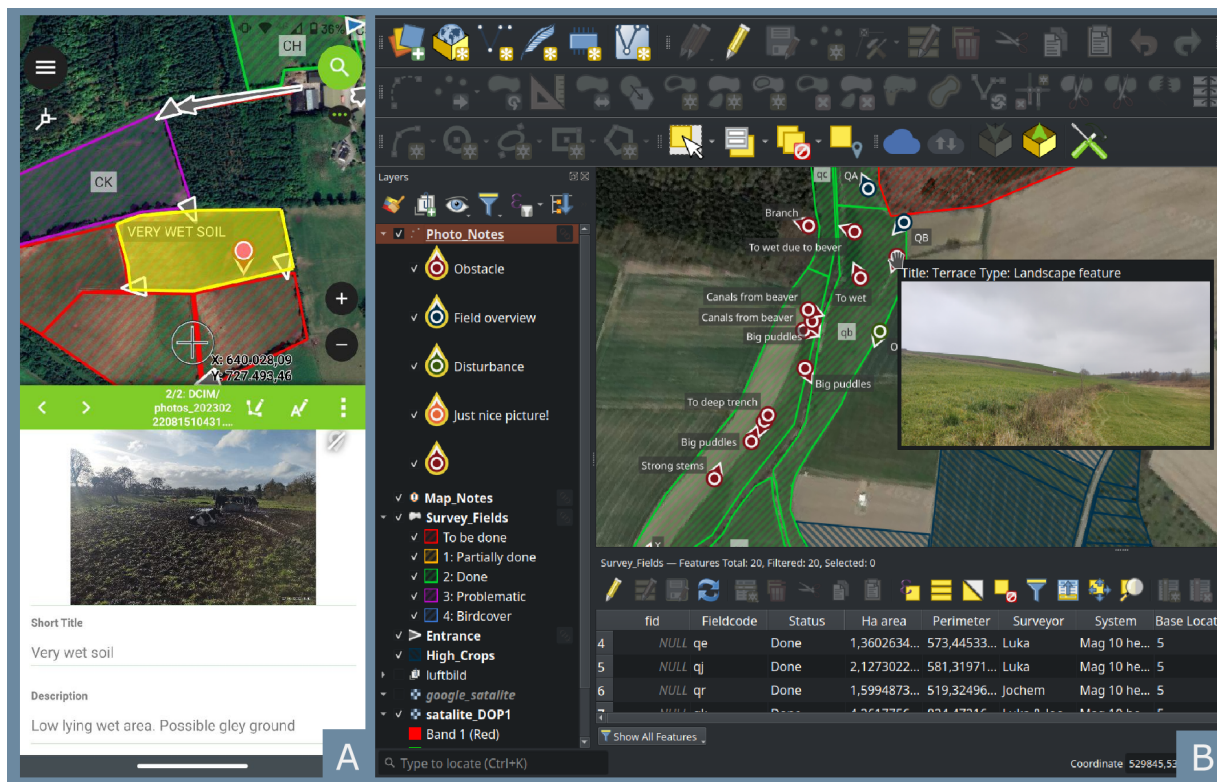


Fig. 2: (A) screenshot of how Qfield looks on your phone, (B) Opening photos and other gathered data with Qfield in QGIS.

depending on the speed. The positioning was realized with the help of an RTK-GNSS. Part of the measurements were conducted using two LEA-MAX systems simultaneously.

Upscaling strategies

By dividing the tasks of (1) the field work (conducting the measurements and documenting the area), and (2) the office work (post processing and interpreting the magnetic data), two teams can work parallel on the same project. For this to work however it's important that there is an elaborate landscape documentation of the area so that the data can be post processed and interpreted as best as possible. To achieve this Qfield turned out to be a very useful application. Qfield is a mobile app that works together with QGIS on a computer. When an QGIS project and prepared Qfield layers are prepared correctly on a computer, it can be transferred to a phone and be opened in Qfield. Using your phone GPS you can now see where you are, add photos with location and direction describing the area, add notes, and add data to shape files of the field that is useful, such as field code, measuring frequency, state of soil, and more

(Fig. 2A). The Qfield data can be uploaded and be opened from the office using normal QGIS) and be consulted during post processing and interpretation (Fig. 2B). The Qfield data will be backed up together with the magnetometry data.

Results

Some impressive examples of archaeological features are shown in Figure 3. Not all of the areas had archaeology visible in the data and did only show Geology or an old drainage systems. More interesting examples will be shown in the presentation.

Discussion

A total of 1442 hectares of magnetometer data have been collected from which 76% were excavated and have been used to ground proof geophysical methods in 2014 (Bonsall et al. 2014). The findings of the evaluation were that magnetometry is a good, effective and fast geophysical method, as long as you a not looking for stone founda-

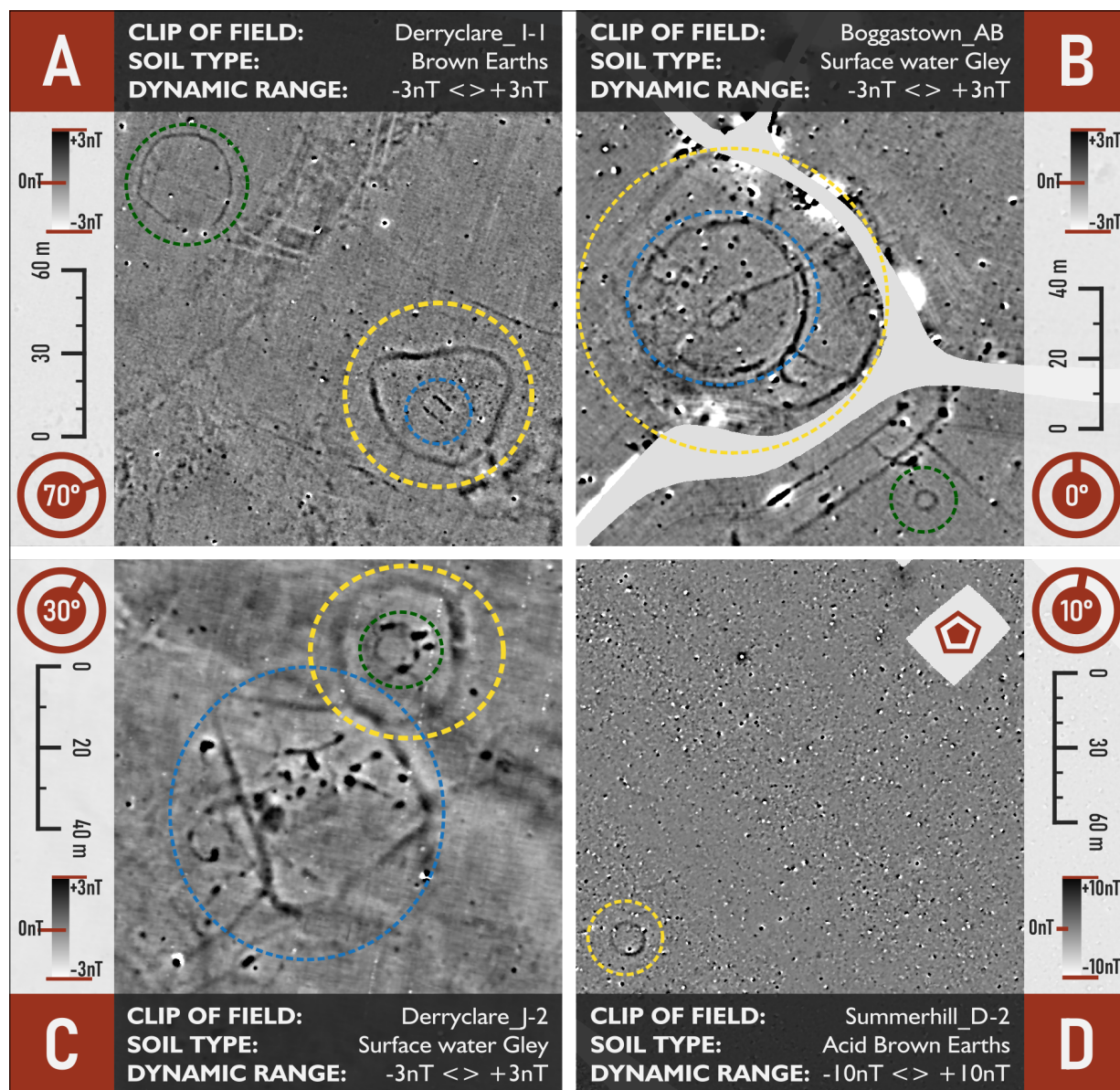



Fig. 3: Some results from the conducted Magnetometry surveys in 2021 and 2022, (A): Highlighted in Yellow can be seen an enclosed area of 1451m² with a deep moat and an entrance in the east. Within this feature a square anomaly can be seen, highlighted in blue, which is probable to be a house of 10 by 6m. In green is a smaller enclosure highlighted of 861m². (B): Highlighted in blue is a round feature encircling 1450m². Concentric to the inner part another ring of defensive ditches is highlighted in Blue at 15m distance. In green is also a possible barrow/tumuli visible of around 5m diameter. (C): In the green circle is a possible round tower visible. This feature is enclosed by a deep ditch highlighted by yellow, which is connected to another enclosure highlighted in blue. (D): At the red pentagon a known barrow/tumuli is documented and protected. Highlighted in yellow you can see the ditch remains of a probable other barrow in the same field.

tions, whose magnetic contrast, and thus visibility in magnetic data is often very minimal, or try to survey in peat soils (Bonsall et al. 2014). Since this study 13 year of new road construction and other infrastructure projects like the solar farm projects we conducted the last two years have resulted in an enormous database of additional magnetometry data. Next to geophysical data also a lot

of remote sensing data, mainly Lidar elevation data, has been collected and released for research and the public. Together with classic sources as other archaeological records and soil science have reached a qualitative and quantitative level of data that enables big data methodologies. Questions regarding social-spatial organization or methods as predictive modelling can help to bring archaeo-

logy to the next level. A drawback of using geophysical and remote sensing methods is that there are no divisive indications towards the age of the found features. But this can be done in retrospect.

Conclusion

The magnetometer surveys presented contribute significantly to „big data“ available today. Further research may continue the evaluation of the methodology for preventive archaeology in Ireland, and can be extended to wider and larger datasets. Additionally, data are still available on which new approaches to interpretation, e.g. routines from remote sensing, can be tested and applied. New developments as Qfield also make it easier to store valuable information about gathered data so that it is easier to use old data again and for other questions. 

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