Using Arduinos to monitor fluvial carbon dioxide efflux during erosion events in peatland catchments

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Aims and Methodology

This application sought funding for the construction of novel equipment to directly monitor CO_2 release an eroding peatland catchment in the Peak District. Existing equipment for this research was unsuitable for extensive field deployment due to cost, weight, and small data storage capacity. We sought to build our own novel CO_2 data loggers using off-the-shelf, low-cost components which would function using an Arduino Uno microcontroller. These loggers had to record accurate, time-stamped CO_2 concentration and atmospheric temperature data and record it using onboard data storage at a considerably reduced cost compared to scientific grade equipment.

Main Findings

Using a Senseair CO_2 Engine K30 NDIR sensor in tandem with an Arduino Uno microcontroller and additional low-cost components, connected by a custom printed circuit board designed through interdisciplinary collaboration with an electrical engineering department, we created a low-cost CO_2 data logger for £155 (Figure 1). It can be powered by USB battery or mains power making it ideal for lab or field deployment. Data storage capacity is vast with 12 hours of 10-second interval data (4323 records) taking up 168 KB of disk space. Post-calibration accuracy of the CO_2 sensor is 96-99% when compared to scientific equipment. While we were unable to undertake the field work as planned, these sensors have enabled substantial expansion of a series of lab experiments to investigate the same hypotheses and novel investigation into the value of DIY equipment to physical sciences.

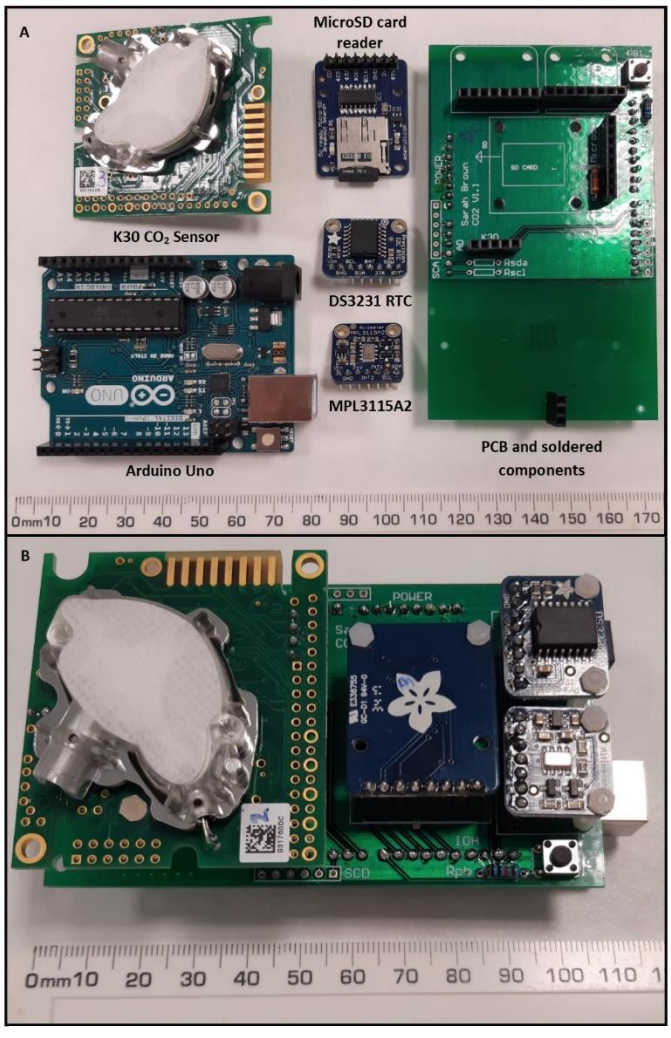

Figure 1: Deconstructed (A) and constructed (B) data logger.

Contribution of BSG Postgraduate Research Grant

The grant enabled us to test out a range of components for inclusion in the final data logger design. This led to the interdisciplinary collaboration described above as well as ongoing work on a systematic review of the historical and future use of DIY equipment in Geography. The data logger designs have been published in HardwareX, an open access journal for the publication of DIY and open-source scientific equipment, where the logger can be freely replicated by future research teams (https://doi.org/10.1016/j.ohx.2020.e00136).