Tools of the trade

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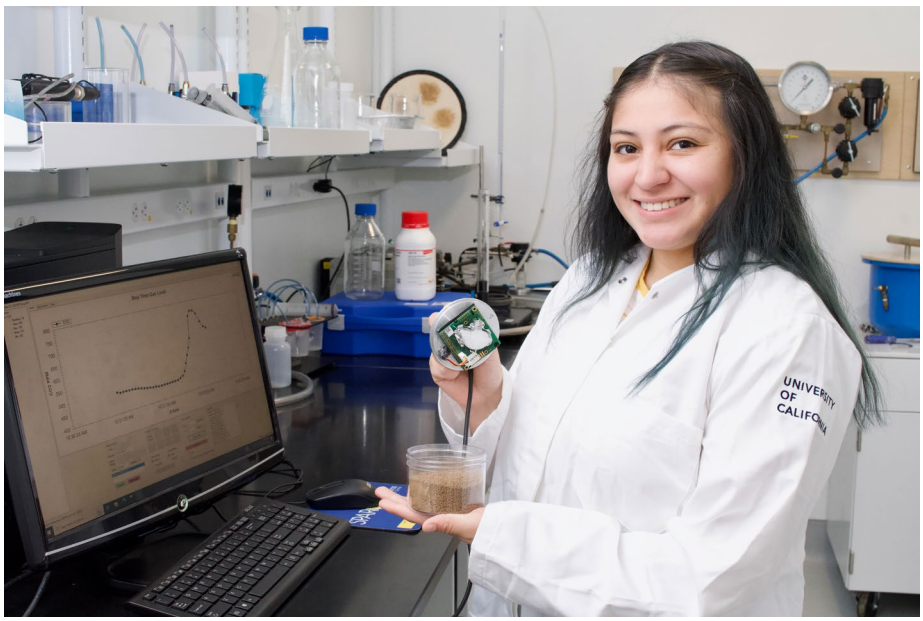
Measuring soil CO_2 emissions with air-quality sensors



Plant roots and soil microorganisms emit nine times more carbon dioxide (CO_2) than anthropogenic emissions annually. Therefore, accurate and frequent measurements of CO_2 emissions from soil are essential for characterizing carbon emissions and understanding carbon sequestration in soil. CO_2 concentrations can be continuously measured with automated chambers connected to an infrared gas analyser (IRGA) or laser spectroscopy instruments. However, these instruments are expensive, labour-intensive and cumbersome to transport.

Alternatively, industrial and building air-quality monitoring meters, such as the K30 Fast Response 10,000 PMM CO_2 sensor, can be repurposed as low-cost alternatives for measuring soil CO_2 fluxes. Their quick set-up time, low maintenance needs and low-power requirements make these sensors ideal for both laboratory and field experiments. In this application, the sensor is attached to a customizable lid to create a flux chamber and start instantaneously recording CO_2 concentrations to a computer with a data logging software (such as GasLab). As these sensors are compact and lack moving parts, they can be adapted for various field experiments by connecting a sensor to a single-board microcontroller that contains an internal battery and internal data logger for self-recording. In comparison to traditional instruments, the K30 sensors are capable of recording intensively fast measurements (as low as every two seconds) with an accuracy of ± 30 PPM (± 3%) and repeatability ± 20 PPM (± 1%) of the measured value, which are within air-quality monitoring product specifications.

Using these repurposed sensors is a feasible and cost-effective way to record fast, precise, and multiple CO_2 measurements from soil. The measurement can provide repeated snapshots of CO_2 emissions in real-time and in space, revealing how fluctuations in the soil's physical environment can regulate soil respiration. Measuring soil CO_2 efflux in different landscapes and timescales can provide insights into the fast exchange rate between the atmosphere and the soil. Finally, using the same sensor for laboratory and field experiments provides consistency of measurements.

Yulissa T. Perez Rojas
Life and Environmental Sciences, University of California, Merced, Merced, CA, USA.
e-mail: yperezrojas@ucmerced.edu

Competing interests
The author declares no competing interests.

Additional information
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