

GC51P-0859 Distributed Carbon Dioxide Flux Assessment in Agricultural Soils: Can Robotic Rovers Monitor Gas Emissions While Carrying the Produce?

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September 09, 2024

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Poster presentation GC51P-0859 at the Fall 2023 Meeting of the American Geophysical Union, San Francisco, CA, December 12-16, 2023

ABSTRACT

Building healthy soils that store more carbon and reduce greenhouse gas (GHG) emissions while increasing food security is a multi-pronged climate action for the world. This work examines affordable technologies for rapidly assessing soil surface efflux of carbon dioxide quickly and accurately at multiple locations over short time periods (approximately 1 hr) in agricultural fields. Soil carbon dioxide efflux or respiration rate is known to be a strong function of soil texture, moisture content, and temperature. Thus, spatiotemporal variation of the efflux signal is complex and dynamic, particularly when soil texture and irrigation patterns are heterogenous. We use a combination of computational modeling and empirical measurement to study this problem at the UC Merced Experimental Smart Farm, on a roughly 2 ha track of flood-irrigated land. Using computation model (Hydrus 1d), we simulate soil conditions and CO₂ emissions for a variety of ambient temperature and irrigation conditions. We calibrated the model parameters using efflux data obtained during multiple sampling campaigns using low-cost CO₂ efflux chambers. Results indicate that relatively elevated emissions occur as key soil pore pathways drain following irrigation events. The timing of these emissions depends strongly on soil texture, with tighter clayey soils causing more dramatic “hot moments” and more

smoothly draining sandy soils. While initial campaigns were carried out by researchers, future campaigns are being planned in which robotic micro-tractors will be equipped with the CO₂ chambers and maneuvered using path planning algorithms programmed to adequately characterize the field-scale CO₂ efflux while performing their primary agricultural functions. In this context, the farmer can monitor and achieve compliance with GHG emission goals with a minimal time investment.