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In-situ diffusivity measurements using solid-state CO_2 sensors

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Due to the biological, physical and chemical complexities of the soil environment, soil respiration is arguably the least well understood component of the terrestrial carbon balance. While chambers are commonly used to measure soil respiration, subsurface gradient approaches have become increasingly popular as solid-state CO_2 sensors become more widely available. Subsurface approaches offer the ability to resolve respiration dynamics on much smaller spatial and temporal scales than surface approaches, which tend to integrate respiration over larger spatial and temporal scales. However, the estimation of soil diffusivity via models or soil core experiments can introduce considerable error into flux estimates gained by subsurface techniques thereby negating their potential benefits. Here we present a method that can be used in tandem with solid-state CO_2 sensors to gain in-situ estimates of soil diffusivity. By perturbing the soil gas concentrations slightly, and continuously monitoring the rebound to quasi-steady-state conditions, this approach is able to estimate the soil gas diffusivity with good accuracy. The theory behind the technique and results of numerical modeling experiment will be presented alongside preliminary laboratory results comparing the approach to traditional methods.