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Assessing Vertical CO2 Production Rates and Surface Fluxes Using Automated Diffusion Chambers

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In recent years soil CO_2 emissions has been the subject of intense investigation because (i) its potential role in amplifying global warming; and (ii) gaseous compounds formed in the soil environment are, in general, good indicator of soil biology and biochemistry. Accurate techniques used to monitor soil CO_2 profile concentrations offers the opportunity to identify localized carbon dioxide sources and potential sinks in the soil, and to understand the processes that control CO_2 production and emission. In this study, we developed a method to continuously monitor soil CO_2concentration, by using a new type of soil diffusion chamber. We estimated soil CO_2 efflux using a new model to determine the vertical CO_2 gradient across the soil profile up to 80 cm depth, in conjunction with models to determine the soil CO_2 diffusion coefficient. Furthermore, we assessed vertical CO_2 production rates within the soil profile. Daily mean value of CO_2 concentration had a significant variation correlated to soil temperature. Moreover, the vertical soil CO_2 concentration showed similar temporal variation at all depths. From January to August 2008, seasonal mean values of soil CO_2 production varied between 1.97 to 6.84 $gC/m^2/day$ across the soil layer 0-10 cm. Between 10 and 20 cm depth soil CO_2 production varied between 0.67 and 2.68 $gC/m^2/day$, and across the soil layer between 20 to 40 cm depth the CO_2 production varied between 0 and 0.02 $gC/m^2/day$. Over the same period, seasonal mean values of modelled soil efflux ranged between 3.12 and 12.96 $gC/m^2/day$. These values correlated well with soil temperature and flux values measured using automated soil surface chamber. We present a simple technique to measure continuously soil CO_2 profile by burying small CO_2 diffusion chambers. Overall this experiment points out the ability to measure continuously, and for prolonged periods of time, CO_2 concentration across a soil profile.