SOIL, WATER, AND CLIMATE
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Tracing the flow of carbon through ecosystems using stable isotope techniques

by

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ABSTRACT

The stable isotope ^{13}C has become a popular tool for tracing carbon exchange between atmospheric and terrestrial reservoirs. Stable isotope techniques have been applied in a variety of ecosystems to partition the component fluxes of net CO_2 exchange (F_N) and have been incorporated into several atmospheric inversion models that estimate the terrestrial carbon sink on the regional and global scales. While the use of stable isotope theory has helped provide valuable insight into the temporal and spatial variability of carbon exchange, there has been some concern about the theory's dependence on several key assumptions that have gone unverified due to limiting sampling techniques. Specific concerns regard the temporal variability of the isotopic composition of ecosystem respiration (δ_R) and its potential influence on ecosystem flux partitioning.

In this thesis, an automated chamber system was combined with stable isotope techniques to evaluate and apply isotopic partitioning theory both in an agricultural ecosystem and in a climate controlled experiment using corn and soybean plants. Further, this new automated sampling technique was combined with isotopic flux-gradient measurements to examine the main factors controlling variability in ecosystem respiration and its isotopic composition. The findings from this thesis research may benefit land surface schemes that simulate isotopic fluxes for input to atmospheric inversion models.