Environmental forcing does not lead to variation in carbon isotope content of forest soil respiration

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Recent studies have highlighted fluctuations in the carbon isotope content ($\delta^{13}C$) of CO$_2$ produced by soil respiration. These have been correlated with diel cycles of environmental forcing (e.g., soil temperature), or with synoptic weather events (e.g., rain events and pressure-induced ventilation). We used an extensive suite of observations to examine these phenomena over two months in a subalpine forest in Colorado, USA (the Niwot Ridge AmeriFlux site). Measurements included automated soil respiration chambers and automated measurements of the soil gas profile. We found 1) no diel change in the $\delta^{13}C$ of the soil surface flux or the CO$_2$ produced in the soil (despite strong diel change in surface flux rate), 2) no change in $\delta^{13}C$ following wetting (despite a significant increase in soil flux rate), and 3) no evidence of pressure-induced ventilation of the soil. Measurements of the $\delta^{13}C$ of surface CO$_2$ flux agreed closely with the isotopic composition of soil CO$_2$ production calculated using soil profile measurements. Temporal variation in the $\delta^{13}C$ of surface flux was relatively minor and unrelated to measured environmental variables. Deep in the soil profile, results conform to established theory regarding diffusive soil gas transport and isotopic fractionation, and suggest that sampling soil gas at a depth of several tens of centimeters is a simple and effective way to assess the mean $\delta^{13}C$ of the surface flux.