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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 (δ13C) 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 δ13C 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 δ13C following wetting (despite a significant increase in soil flux rate), and 3) no evidence of pressure-induced ventilation of the soil. Measurements of the δ13C 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 δ13C 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 δ13C of the surface flux.