

Bai, E., Boutton, TW, Liu, F, Wu, XB, Hallmark, CT, Archer, SR. 2011. Spatial variation of soil $\delta^{13}\text{C}$ and its relation to carbon input and soil texture in a subtropical lowland woodland. *Journal Geophysical Research – Biogeosciences*: In Press

Abstract

Spatial patterns of soil $\delta^{13}\text{C}$ were quantified in a subtropical C_3 woodland in the Rio Grande Plains of southern Texas, USA that developed during the past 100 yrs on a lowland site that was once C_4 grassland. A $50\text{ m} \times 30\text{ m}$ plot and two transects were established, and soil cores (0-15cm, $n = 207$) were collected, spatially referenced, and analyzed for $\delta^{13}\text{C}$, soil organic carbon (SOC), and soil particle size distribution. Cross-variogram analysis indicated that SOC remaining from the past C_4 grassland community co-varied with soil texture over a distance of 23.7 m. In contrast, newer SOC derived from C_3 woody plants was spatially correlated with root biomass within a range of 7.1 m. Although mesquite trees initiate grassland-to-woodland succession and create well-defined islands of soil modification in adjoining upland areas at this site, direct gradient and proximity analyses accounting for the number, size, and distance of mesquite plants in the vicinity of soil sample points failed to reveal any relationship between mesquite tree abundance and soil properties. Variogram analysis further indicated soil $\delta^{13}\text{C}$, texture and organic carbon content were spatially autocorrelated over distances (ranges = 15.6, 16.2 and 18.7 m, respectively) far greater than that of individual tree canopy diameters in these lowland communities. Cross-variogram analysis also revealed that $\delta^{13}\text{C}$ – SOC and $\delta^{13}\text{C}$ -texture relationships were spatially structured at distances much greater than that of mesquite canopies (range = 17.6 and 16.5 m, respectively). These results suggest fundamental differences in the functional nature and consequences of shrub encroachment between upland and lowland landscapes and challenge us to identify the earth system processes and ecosystem structures that are driving carbon cycling at these contrasting scales. Improvements in our understanding how controls over soil carbon cycling change with spatial scale will enhance our ability to design vegetation and soil sampling schemes; and to more effectively use soil $\delta^{13}\text{C}$ as a tool to infer vegetation and soil organic carbon dynamics in ecosystems where C_3 - C_4 transitions and changes in structure and function are occurring.