Geophysical Research Abstracts
Vol. 21, EGU2019-18512, 2019
EGU General Assembly 2019

Plant-water sources and water use strategies in a traditional shade coffee agroforestry system

Lyssette Munoz Villers (1), Josie Geris (2), Susana Alvarado Barrientos (3), and Friso Holwerda (4)

(1) Universidad Nacional Autónoma de México, Centro de Ciencias de la Atmósfera, Mexico city, Mexico (lyssette.munoz@atmosfera.unam.mx), (2) University of Aberdeen, School of Geosciences, Aberdeen, United Kingdom (j.geris@abdn.ac.uk), (3) Instituto de Ecologia, AC, Red de Ecologia Funcional, Xalapa, Veracruz, Mexico (susana.alvarado@gmail.com), (4) Universidad Nacional Autónoma de México, Centro de Ciencias de la Atmósfera, Mexico city, Mexico (friso.holwerda@gmail.com)

Globally, coffee is one of the most important commercial crops and it will increasingly be affected by climate change over the next decades. Among the different cultivated varieties, the Arabica coffee (Coffea arabica) grown in traditionally shaded agroforestry systems accounts for $\sim$ 70% of the coffee production worldwide. Growing a crop in association with shade trees inevitably results in some degree of competition for the above-ground (light) and below-ground (water and nutrients) resources. Although the outcome for light competition is relatively predictable due to the hierarchical structure of the canopy, the competitive interactions for soil resources can be much more diverse and complex, and to date, experimental data on soil water use partitioning in coffee agroforestry systems are extremely scarce. To investigate the plant water sources and water use strategies of dominant shade trees species (Lonchocarpus guatemalensis, Inga vera and Trema micrantha) and coffee (C. arabica var. typica) shrubs under different soil water availability conditions, we conducted a study during a normal and more pronounced dry season (2014 and 2017, respectively) and the 2017 wet season in a traditional shade polyculture system in central Veracruz, Mexico. For the different periods, variations in water sources and soil depth uptake were examined via MIXSIAR mixing models using δ18O and δ2H stable isotopes of rainfall, tree xylem and soil water in combination with micrometeorological and soil moisture measurements. To further increase our understanding about effective rooting depth, the distribution of belowground biomass and soil macronutrients were also examined and considered in the model. Results showed that, over the course of the two dry seasons investigated, all shade tree species relied on water sources from deeper soil layers (30-120 cm depth; 87%), while the use of much shallower water sources (0-15 cm; 71%) was predominantly observed in the coffee shrubs. Our findings also showed that during the wet season coffee shrubs substantially increased the use of near surface water (+47%) from just [U+02C2]5 cm depth, while shade trees extended the water acquisition to much shallower soil layers (+1% from near surface, and +30% from 0-15 cm depth) in comparison to the dry season. Despite the plasticity in soil water uptake observed among canopy trees and coffee shrubs, a spatial segregation of the main water source prevailed during the dry and wet seasons investigated. However, more variability in plant-soil water uptake was observed among species in the wet season when higher soil water availability conditions were present.