Geophysical Research Abstracts
Vol. 18, EGU2016-13657-1, 2016
EGU General Assembly 2016

Tapping another water source: lianas' and trees' below ground competition for water

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Recent studies indicate that liana abundancy in the Amazon is increasing during the last decades. The dominant underlying mechanism of this liana proliferation is currently unknown. However, several hypothesis have been proposed to answer this phenomenon among which one ascribes lianas, in comparison to trees, being able to adapt better to increased drought conditions resulting from climate change. Moreover, some studies indicate lianas having a deeper root system compared to tropical trees, which would allow them to tap water from deeper soil layers and thus increases their belowground competitiveness.

In order to test this hypothesis, water stable isotopes (δ2H and δ18O) were measured in precipitation, bulk soil (at different depths), stream, and xylem water from lianas and trees. This was done in two catchments with different soil texture (sand and clay) in the close vicinity of the Guyana flux tower at Paracou (French Guyana) during October 2015. According to recent studies using water stable isotopes (δ2H and δ18O) have described an ecohydrological separation of water. A mobile soil water compartment, compounded by stream and precipitation waters (or LMWL); and a low mobility or static water compartment mainly used by plants (i.e. xylem water) indicated as the "two water world hypothesis", suggesting that vegetation is using water that is not contributing to stream water. Based on this concept, we further characterized all isotopic data by estimating the precipitation offset (Pp-offset) which represents the distance between the LMWL and xylem δ2H and δ18O signature.

Our results show that in both catchments, lianas and trees use different sources of water, with lianas tapping water with a significant heavier isotope signature (i.e. shallower water sources) compared to the lighter isotopic signatures observed on tropical trees (i.e. deeper water sources). Soil texture only affected tree water sources, with heavier isotopic xylem water found in trees growing in sandy soil. In addition, our results support "the two-water-world hypothesis", and show that lianas and trees on clay soils have very different Pp-offsets. This difference was not found for lianas and trees in sandy soils, suggesting that lianas and trees are using water with a different isotopic signature, therefore, distinct water sources in clay soils, but not in sandy soils.

In conclusion, our study shows that xylem water from lianas has a heavier isotopic signature than those observed in trees xylem water. Therefore indicating that belowground competition for water between lianas and trees might be less strong than previously expected.