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A stable isotopic view on liana and tree competition for soil water during dry and wet season

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Recent studies highlight distinct liana abundance and biomass increase in the Neotropics in the last decades. Despite several explanatory hypotheses have been proposed, the dominant underlying mechanism of this liana proliferation is still unknown. One hypothesis ascribes lianas, in comparison to trees, being able to adapt better to increased drought conditions resulting from climate change. Moreover, lianas are indicated of having a deeper root system compared to tropical trees, providing access to deeper soil layers less susceptible for dehydration during drought events, increasing the lianas belowground competitiveness for water. However, this deep root hypothesis was recently questioned in the stable isotope study of De Deurwaerder et al. (2018), where lianas showed surface root activity during the dry season in Paracou, French Guiana.

In order to acquire a more complete insight in below ground water competition between lianas and trees, we performed two extensive field studies in the tropical rainforest of French Guiana. One study was performed at the end of the wet season (Paracou; Deuterium enrichment; Augustus 2017) and the other during the dry season (Laussat; Natural abundance; September 2017). Conform De Deurwaerder et al (2018) we considered two catchments with different soil texture (sand and clay) for both studies. Water stable isotopes (δ2H and δ18O) were measured in precipitation, bulk soil (at different depths), stream, and xylem water from lianas and trees. In addition, soil water potential measurements were performed to unravel the putative mechanism of the dry season water resource partitioning. Elaborated plot measurements, i.e. diameters and spatial location, help in understanding how the 'water competition'-spheres of trees and lianas are influenced by each other. Where xylem water isotopic water signatures are directly related to the depth of root activity, we are able not only to show individual difference in the depth of bulk water uptake, but have direct indication of water competition alterations between dry and wet season.

In conclusion, our study provides the first in depth water competition overview between lianas and trees during both the wet and dry season. These new insights highlight seasonal alterations of water competition with the occurrence of dry seasonal water resource partitioning. These new insight show high potential in the understanding of the dry season growth advantage of lianas as well as the liana proliferation during the last decades.